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FRACTURE OF THE PATELLA

FRACTURE of the patella presents a number of features peculiar to itself, most of which, obviously, are the result of the fact that the patella is a sesamoid bone developed in the tendon of the quadriceps extensor muscle. The patella takes part with its free cartilage-covered surface in the construction of the knee-joint, and because of its anatomic position is obliged practically to transmit the entire force of contraction of the quadriceps extensor muscle group, far and away the most powerful muscles of the body, to concentrate their force on a single tendon.

Some idea of the force transmitted by the tendon of the quadriceps and, therefore, a conception of the stress the patella is called upon to bear can be had by considering the effort the quadriceps muscle puts forth when a person of average weight rises from a squatting position on one leg. Such a movement occurs in certain Russian dances. To make the matter concrete, the action is that of a lever of the third order in which the shaft of the femur represents the weight arm, the weight of the body the weight to be moved, the power arm the short distance between the center of the patella and the center of curvature of the lower end of the femur. For a man of average size the weight exclusive of the weight of the leg may be taken as 150 pounds, the weight arm 18 to 20 inches, the power arm $1\frac{1}{4}$ to $1\frac{1}{2}$ inches. From these relations it can readily be seen that the force exerted by the quadriceps muscle and transmitted by the

patella may reach 2000 and even 3000 pounds. Under conditions of mental stress, fear, or reaction in the case of accident the force exerted may be momentarily vastly greater. Moreover, because of the fact that most of the tendon is inserted into the edge of the patella, the pull of the quadriceps tendon is at a definite angle when the knee is flexed, sometimes even an acute angle, with the direction of the pull on the patellar tendon. For this reason the tensile forces are greater on the dorsum of the patella than on the visceral surface, and it is because of yielding to these tensile forces that the patella breaks.

The lower fragment is small partly also because of the conical or triangular form of the bone, *i. e.*, it tapers toward its lower end, the patellar tendon being only about half as wide as the quadriceps tendon above, from which it follows that there is barely half as much bone to resist the rending force there as there is in the upper third.

A remarkable circumstance is that it is rare for the tendon to pull away from the patella. Nature has a way of attaching tendons and ligaments to bones which surgery has not learned successfully to imitate.

In the vast majority of instances the fracture by muscular traction is transverse and located in the lower third of the bone. Not merely is the bone broken, but those portions of the quadriceps tendon which lie over the dorsum of the patella are torn into shreds, and unless the tensile stress suddenly ceases the lateral expansions of the quadriceps tendon and aponeurosis at the sides of the patella are also pulled apart.

The fragments are thus separated a corresponding distance. The knee-joint is filled with blood and a certain amount of arthritis is set up.

Fracture of the patella by direct violence—"blow on the knee-cap"—is erratic in form, according to the severity of the blow and its point of application. It is essentially a crushing or comminution of the bone, but in the nature of the case unless powerful contraction of the quadriceps occurs subsequent to the crushing there is little displacement of the fragments, for the fibrous tissues about hold them as in a sac. For this reason

fracture of the patella by direct violence seldom requires other treatment than simple fixation, and bony union results. Any disability following is apt to be due to concomitant injury to the joint, hemorrhage, irregularity of the articular surface of the patella, etc.

The case before us is a typical example of fracture of the patella by muscular effort, *i. e.*, the line of fracture is transverse; the fragments are separated several centimeters, perhaps five; the lower fragment is much smaller than the upper; there is a sharp fluctuant swelling over the front of the knee, really between the fragments; the skin over it is discolored.

The patient is a strongly built, middle-aged man. When asked how he received the injury he stated that he made a quick jump to avoid an approaching automobile, that he fell, striking his knee on the pavement, and he thinks that the blow broke his knee cap. A common history, but it is clear from the location of the fracture line and the displacement that the patella gave way under muscular effort and only secondarily struck the ground.

x-Ray plates show that the lower fragment is not only smaller than the upper, but is comminuted. It is probable that this comminution resulted from the blow on the pavement.

In preantiseptic days fracture of the patella was treated by fixation with posterior splint, the upper fragment being held downward by bandaging—generally with narrow white muslin bandages put on obliquely by passing the turns around pegs on the sides of the posterior splint. The skin was cleansed and washed with soap and water or, better, with ether to remove the fat, and the bandage put on wet so as better to cling to the skin.

Fibrous union always resulted, and the fibrous band which formed between the fragments later stretched so that the final result was a separation of the fragments of 3 to 10 cm. A small separation would be well compensated for by shortening of the quadriceps muscle, but a large separation would limit active extension of the leg and be the cause of serious disability—uncertainty in locomotion because of lack of control of the leg in extension, and frequent recurrence of fracture because of

sudden bringing into play of the force of the quadriceps when the bone would be violently flexed.

It was William Macewen, of Glasgow, who showed the cause of the failure of treatment by splint and bandage to secure bony union, viz., the fact that the portions of the quadriceps tendon and aponeurosis which pass in front of the patella are torn, *i. e.*, pulled apart into irregular tabs. These fall into the fracture and effectively prevent bony contact, even when approximation of the fragments is apparently satisfactory, but there is another reason which is probably of some importance. The patella consists of cancellous bone, and it is notorious that cancellous bone does not produce abundant callus, and in spite of the fact that there is always ample blood-clot between the fragments to favor the growth of bone cells, the fragments hardly increase in size at all. They are finally merely smoothed off. It is simply another application of the well-known clinical fact that fractures of the articular ends of bone do not produce much callus, whatever be the reason whether some essential peculiarity of epiphyseal bone, or the inhibiting effect of the synovial fluid on bone growth.

For these reasons the only satisfactory treatment of transverse fracture of the patella is open operation, best done through a transverse incision, curetting away blood-clot which is adherent to the raw surfaces of bone, evacuating the joint, removing any loose fragments of bone, and then suturing the fragments together. Chromicized catgut and kangaroo-tendon are often recommended, but they are notoriously unreliable and, in general, are absorbed before bony union has time to take place. A stout silver wire is by far the best suture material. It is best applied through the bone and may then remain indefinitely.

In this particular case the torn fragment is so small and so comminuted that it is not possible to drill the bone and thread the wire through in the ordinary way. Under these circumstances the wire is best passed in a coronal plane through the upper fragment, then around the lower fragment, passing through the patellar tendon in such wise as not to disturb the attachment of the tendon to the bone.

The lateral tears in the aponeurosis are trimmed and sutured with interrupted fine kangaroo-tendon or chromicized catgut, the fascia separately united over the sutured patella with silkworm-gut suture to the skin.

In the after-treatment no splint is applied, but in a day or two, as soon as the immediate soreness permits, active motion is prescribed. The patient is gotten up on crutches and encouraged to swing his leg and bend and straighten the knee with the muscles of the thigh. If this is difficult to accomplish, the patient is set upon a table with his legs hanging over. Gravity will flex the knee with a minimum of discomfort.

After wound healing crutches are worn for some six or eight weeks, this more by way of protection against excessive force being applied to the knee than as a means of support. After three months the knee may be forgotten. By this time there is ordinarily no need for favoring it. The patient may even go up and down stairs with impunity.

It goes without saying that asepsis in such an operation should be as nearly absolute as possible, for infection may bring disaster and is always serious.

It may be interesting to note in passing that Dr. Elias S. Cooper, of San Francisco, successfully wired the fractured patella and olecranon in 1860. He claimed wonderful curative properties of the air of San Francisco, but at the same time washed his hands, instruments, and wounds in alcohol.

The surgeon is occasionally asked to lessen the disability due to separation of the fragments in an inefficiently treated fracture of the patella. There seems to be no limit of time beyond which satisfactory union cannot be gotten, even in case of wide separation of the fragments.

In a middle-aged Chinese in this hospital, about thirty years ago, we operated on such a case of untreated transverse fracture of the patella upward of three years old. The fragments were exposed as usual, the fibrous cord which joined them was cut away, the bony surfaces freshened with a saw, and a triangular scar in the aponeurosis on each side removed. The upper fragment was about 20 cm. above its proper position, and this

necessitated oblique cutting of the quadriceps aponeurosis and some of the muscle in order to bring it down into contact with the lower fragment. After wiring, bony union occurred with excellent function, though flexion was somewhat limited by rigidity of the quadriceps.

It occurs to me that the method of lengthening the quadriceps employed by Professor Putti, of Bologna, in his arthroplasties of the knee-joint would be ideal in this condition.

CLINIC OF DR. FRANK W. LYNCH

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TREATMENT OF SQUAMOUS-CELL EPITHELIOMA OF THE CERVIX

W. H., fifty years of age, No. 50,564, entered complaining of a slight vaginal bleeding for the greater part of the last year. Her family history is negative save that her maternal grandfather died of cancer of the face at sixty-eight. The history, however, is not accurate, since the patient knows the life history only of her own and her parents' generations.

The *past history* is rather uneventful. Until forty-one she lived in Texas, where she was born, coming then to Nevada. She had the more usual childhood diseases, but no scarlet fever. She has had malaria in childhood, typhoid in youth, and the "flu" in 1918. Her appetite is good. Her bowels move regularly. She sleeps well, has had no dysuria, is not subject to colds, has no cough, no edema, and complains only of shortness of breath when climbing in the considerable altitude in which she lives. Her weight has averaged 145 to 148 pounds. Her present weight is 152. Her best weight is 155.

Her *menstrual history* is practically negative. It began at seventeen. She flows regularly at twenty-eight-day intervals, moderately, and lasting four to five days. She has always had backache with her periods. Just prior to twenty years she had intermenstrual leukorrhea. She has not had the menopause. A slight intermenstrual bleeding began nearly a year ago, but was not considered of importance by the patient since it was just enough to present as a stain. Her last period was twelve days prior to entry.

Marital History.—She has been married for twenty-nine years. She has had 4 children and one spontaneous abortion at

the second month. One child is living and well at the age of twenty-four. Two children died in infancy, and one at twenty-two of diabetes. All the pregnancies, the abortion, the labors, deliveries, and puerperia were normal except for a low fever for about two weeks following the birth of her second child.

Present Illness.—During the last year she has had symptoms which she attributed to change of life, since after her regular menstruation a slight bloody discharge appeared regularly four or five days after the period had ceased and lasted for the greater part of the intermenstrual interval. It has never been a great deal in amount, just enough occasionally to stain her clothes and rarely enough to necessitate wearing a pad. During the last six months she has tired more easily and has felt some loss of strength. She has had no pain, no backache, no headache, no rectal or urinary symptoms. There is no loss of weight. She has gained weight during the last two or three years. There has been no leukorrhea, nothing except the slight vaginal bleeding.

On physical examination the patient appeared as about her stated age, did not look sick, and presented no physical findings save those in the pelvis. The heart was negative. The blood-pressure was 100/55. The laboratory findings showed that the hemoglobin was 65 Sahli, and the red blood-count was 3,480,000. The white blood-count was 10,400. The differential showed, P. M. N. 54 per cent.; S. L., 42 per cent.; L. L., 1 per cent.; T., 2 per cent.; and E., 1 per cent. The urine was likewise negative, being clear, amber, acid, without albumin, sugar, or casts. The specific gravity was 1022 with white blood-cells—one to a high dry field.

On pelvic examination the cervix was found enlarged and contained a mass about 4 cm. in width with a suspicion of thickening toward both broad ligaments. There was a shallow ulceration around the cervix for 3 cm. in width. The mass appeared hard, irregular, of the worm-eaten type. There were no glands palpable. By rectum there was some slight thickening of the right broad ligament.

The patient of fifty years was, therefore, negative from the fact that she had no pain, had lost no weight, had no symptom

whatsoever save that of a blood-stained discharge which has lasted the greater portion of the intermenstrual period. She is in the menopause age and for that reason had not consulted a doctor until quite recently, when her physician, feeling the tumor, sent her to us for treatment.

This case from the history presents to us an ulcerating tumor of the cervix for which there are, ordinarily speaking, three possibilities, although only one seemed probable. The possibilities are syphilis, tuberculosis, and cancer. At the present time these are the only conditions which could simulate this appearance. Syphilis is excluded because the Wassermann is negative and there is no history of the disease. The mass was larger and of a type different from that seen with syphilis. The syphilitic mass is usually softer and smaller. Tuberculosis enters into the remote probabilities, although this rarely gives the deep-seated infiltrated mass. There is always the possibility, however, that a mass of considerable size may be created by infection of a previous standing ulcer. On feel and appearance and history the mass was undoubtedly carcinoma, and a squamous-cell epithelioma of the vaginal part of the cervix.

At the present time, when the etiology of cancer is unknown, our interest is largely centered in diagnosis and treatment. Diagnosis and treatment go hand in hand and should be considered in close relation. The early diagnosis of a cancer is made by biopsy, yet it is well known that biopsy should never be undertaken unless it is followed immediately by active treatment. The habit of removing cervical tissue for biopsy and waiting for days the reports of the pathologist is a ridiculous one, which would be laughable if it were not usually followed by disastrous results, since even a tumor which may have been lying dormant can be excited thus to active proliferation. Unfortunately, it is a habit of men doing gynecology to remove tissue and send it to the laboratory for examination, not usually for frozen section diagnosis, but for examination only after the tissues have been fixed, hardened, and run through paraffin or celloidin, which at the best means a loss of several days. The same surgeon, who would not dream of removing suspicious

tissues from the breast, tongue, or lip unless it was followed by immediate operation, or active treatment, does not appear to realize that cancer is cancer, no matter in what part of the body it may be encountered. We have made a diagnosis, and have made our treatment in a way which we will later describe.

There is no doubt that cancer is on the increase, and comparatively little doubt that it is now seen more often in the young than in preceding generations. Cancer invariably kills, and kills in a few years, so it is not at all likely that in past generations cancer remained as an unrecognized disease for years which killed only in middle age. Cancer deaths are so distressing that neither the family nor the physician is likely to remain forever in error as to the cause of death. In California we are constantly seeing more and more cases in the very young. During the last few months we have seen undoubted cancer in women of twenty and twenty-two, as a primary carcinoma of the vagina and as a primary cancer of the uterine cervix, and have operated two others in their thirty-second year. In a table prepared nearly three years ago 4 per cent. of 160 squamous-cell epithelioma of the cervix were thirty years and under; 25 per cent. were between forty and forty-nine; 29 per cent. were between fifty and fifty-nine; 14 per cent. were between sixty and sixty-nine; and 4 per cent. were more than seventy-one. Nearly all the vital statistics tend to show that cancer is on the increase. Unfortunately they show that there are more cancer deaths in San Francisco than in any city in the United States. Von Hoffmann recently made a survey, and is inclining to the belief that the cancer deaths on the Pacific Coast are not largely among people who have come to the coast late in life, because his statistics suggest that people dying from cancer in California have been in the state for an average of nearly twenty-eight years.

The relation of cancer of the uterine cervix and pregnancy is also of interest, since pregnancy is usually held as a *sine qua non* of the disease. Several of these 160 cases have borne many children. There were 7 who had from 10 to 17. On the contrary, there were 27 of the 160, or $16\frac{7}{8}$ per cent., who never had been pregnant. Many of these cases were virgins.

The treatment of cancer of the uterine cervix has excited the greatest discussion. We limit our discussion to the squamous-celled cervical carcinoma because adenocarcinomas of the uterine fundus differ so tremendously in their method of growth that it is not logical to consider as one group all the cancers of the uterus. As you all know, up to comparatively recent time treatment has been limited to caustics or to surgery. Caustics have been abandoned as useless from the standpoint of cure by nearly all except the so-called cancer quack. Surgery, for which much has been claimed, is now known to be very disappointing. Now that radium has come into use, with or without the deep ray, many have abandoned surgery, believing that better results may be obtained from radium than from surgery.

I am taking the opportunity this morning of reviewing with you the treatment of squamous-cell cancer of the cervix which we have adopted as the result of our experience. Quite naturally our ideas have been modified from time to time, hoping as nearly all do in the course of development that a newer treatment may prove to be more successful than one whose limitations are well known. We have used in our treatment surgery, radium, and the *x*-ray.

During the last ten years we have treated nearly 400 pelvic cancers in our service at the University of California Hospital. We have made every attempt to follow these in order to know the success or limitations of our treatments, and upon this study have spent a large sum of money for follow-up purposes. The result of our follow-up, however, is only moderately good, since some important cases have been lost to view. While our follow-up compares most favorably with those of other American clinics, it cannot be compared to Wertheim's, who followed 800 cases for a period of five years, losing track of only 1 case. Our present experience insists that the ordinary panhysterectomy with the removal of the tube and ovaries is useless from the standpoint of cure because the growth is insidious and has usually extended beyond the confines of the uterus when operation is attempted. It is as illogic to do a hysterectomy for a cancer of the cervix as to remove a cancer of the lip with an incision which barely

removes the cancerous margins which are visible to the eye. The ordinary hysterectomy cannot be radical except in the rarest of cases, since the ureters so closely parallel the sides of the upper cervix where the lymphatic circulation is most abundant. I have never seen a cure of squamous-cell epithelioma of the cervix where the diagnosis was apparent to the naked eye. The few exceptions of cure which I have seen from ordinary hysterectomy, either on my own service or in those of others for whom I formerly assisted, were limited to the few in which the disease was microscopic in character and presented no definite lesion to the eye. Yet there is no doubt that hysterectomy at the present time is the ordinary method of treatment for cervical cancers. The physician is likely to tell the patient and family that the chances of cure are entirely against the patient; that there are only a few chances in a hundred of saving the patient's life, yet that operation should be attempted to give the patient the only chance. Nothing is farther from the truth. If the disease is not limited to a microscopic area the ordinary hysterectomy has no chance whatsoever to cure. On the contrary, both radium alone or radium together with the extended operation promises more.

This radical operation, as you know, was proposed by Ries in 1899, and was tried in 1895 by Werder, Clark, and Stumpf, but, beginning in 1898, was popularized by Wertheim, whose name is generally attached to this procedure. While the operation is not Wertheim's by virtue of discovery or description, this surgeon deserves the greatest credit for popularizing the procedure. When this operation was new much was claimed for it. It was believed to be radical, since it freed the ureters so the ovaries, tubes, parametria, and half the vagina could be removed in one piece. It is of interest that when Wertheim first began his work radical resections of the breast were comparatively common procedures. Halsted long before taught that cure of mammary cancer could be accomplished only by removal of the patient's skin, fascia, muscles, and glands. Nearly all the well-known surgeons of the world already had abandoned the less radical operations for cancer of the breast. Indeed, many had

developed a technic which aimed to remove the glands above the clavicle as an ordinary procedure in a breast operation.

Yet it presents as a curious phenomena of the human mind that many of the same surgeons who routinely did radical operations for the breast limited the operative treatment of cervical carcinoma to the simple removal of the uterus, with or without the tubes or ovaries. Yet the reason is clear. The extended operation was attended with tremendous primary mortality, and as Clark and others have emphasized, also with great morbidity, nor was it entirely certain that women who had undertaken this hazardous operation had a chance of cure. Moreover, it was recognized as a most difficult procedure and one which should not be lightly undertaken. All surgeons dread primary mortality. Quite naturally the world waited for reports of experts, in the meantime doing simple hysterectomies, shutting their eyes to the future, actuated by hope of cure and a comparatively small operative mortality.

When radium was introduced its cost was prohibitive. The medical world also regarded this as another experiment. Surgeons felt that the majority of men undertaking radium treatment were not surgically trained, and waited, in consequence, definite reports before abandoning their type of surgery which they had followed for years. They viewed with proper skepticism the reports of six-month, one-year, and two-year cures which presently flooded the literature, knowing as they well did that even many untreated cancers might survive even longer periods. Nine years ago we took up the radium treatment in the University of California Hospital. Before that time I had used radium in a small group of cases without being able to follow results. Because our radium was limited to 90 mg., 50 only of which was in convenient form for application, we followed the method of Schmitz, which at that time was strongly urged in the literature. The doses were comparatively small and repeated at intervals for four to five applications. Three years later a large supply of radium was available. We then reviewed our cases. Many were doing well, and at that time there was no reason for change in method. Not until a number of cases which presented as

two and one-half year clinical cures succumbed later with evidences of tremendous intra-abdominal extensions did we realize that our apparent cures had consisted in cleaning up the infected ulcer and had not arrested the disease. We have already called attention to the rôle of the infected ulcer in the symptomatology.

Even a simple ulcer of the cervix which becomes markedly infected may give symptoms identical with those of early cancer, to wit, hemorrhage, leukorrhea, malaise, and possibly some backache. It does not kill, nor does cancer until metastases have invaded the body or there is a blood-stream infection from the infected foci. To clear up the ulcer is, therefore, the most important thing in palliative treatment. It takes away the drain upon the system by cleaning up at the same time both the infection and the ulcer. This, I believe, was all that our first treatments were accomplishing. Workers in the Memorial Institute had changed their methods of application, having available an enormous supply of radium for their work. They called attention to the fact that the best chance of cure was to insert the tube in the center of the pelvis, *i. e.*, the cervix, so that radiation could be obtained not only above the growth, but through it and below it in the sides by cross-firing. For that purpose the cervix was dilated and the radium inserted above, at, and below the site of the lesion. Time has proved that in our cases this method was not without its disadvantages, since it seems likely that the trauma attendant upon the dilation of the cervix even to the point of admitting the screened tube overcame much of the good which was accomplished by cross-firing. Therefore we have abandoned the dilatation and, for the past few years, have burned with the actual cautery the hole in which the radium is to be embedded. We also needle the periphery of the tumor by the so-called seed implants of small size, containing 1 mc. or less. There is no essential difference in the treatment whether you work with emanations or salt, except in the case of the "seed implant," which must be emanations. Our actual results with the latter type of treatment are not known, since it is unfortunate that any form of cancer treatment must be tried for at least six

or seven years before you will know what you have accomplished. This opens the discussion as to what constitutes a cure.

Largely because of the efforts of Winter the gynecologic world in 1907 agreed that five years freedom from operation should be considered a cure. When so agreeing, it was known that the disease might kill even later, but the percentage was extremely small. At that time surgeons held that in breast cancers three years' freedom from cancer after removal was considered a cure. The five-year period was adopted for gynecology because there was not as good a chance of removing all cancerous foci in the pelvis as in the breast. Yet the agreement for uterine carcinoma was not easy of accomplishment. For six or seven years Winter had occupied much of his time in urging that we could not hope to make advances in the study of the disease until we had agreed as to terms. The medical world was loath to adopt the five-year period because of the great difficulties attending the following of the cases for such a prolonged period, yet in Winter's series of 350 operative cases there were two positive and two possible recurrences after five years. Seitz found 3 per cent. of recurrences in von Winckel's clinic in the fifth year. In Wertheim's first 250 cases there were 78 recurrences, 3 of which were in the fifth year. In the 169 cases of Wertheim that had been followed six to eight years Weibel in 1914 found recurrences in 7.7 per cent. Of this number, totaling 13, 6 developed in the sixth, 5 in the seventh, and 2 between the seventh and eighth years. Quite naturally these late returns were recognized by advocates of less extended operations as reasons for the simpler method in that it gave some primary operative relief. They overlooked, however, the point that many of the late recurrences were seen in cases which were operable only with the extended operation, but which could not be treated with the more restricted surgical methods. Late recurrences had also been noted in series that were treated by the cautery method of operating. Werder reported eight recurrences five to nine years after operation in a series of 87 cancers in which hysterectomy was accomplished by the cautery knife. More recently the question of the time which must be considered a cure has again excited attention. The

American College of Surgeons two years ago appointed a committee to ascertain the difference between the three- and five-year cures in America. Greenough has made his first report. Our personal results, however, have shown that, whether the series of cases has been operated or radiated, the true results are not apparent until the fifth year. In 59 cases, operable and inoperable, that we treated by radium alone or by radical surgery we have 32.3 per cent. cures for three years; when the same cases have been followed for five years the percentage of cures falls to 18 per cent. This is in keeping with the work of a number of men who have had extensive experience with radium. Bumm in 1919, in contrasting the differences between the percentages of cure following radium alone or surgery in operable and borderline cases of carcinoma of the cervix, found that when he followed his cases for only three years the results of radium surpassed those of operation, whereas when the cases were followed for six years there were one-third less six-year cures with radium than by operation.

Up to July 1, 1925 we have treated 175 carcinomas of the uterine cervix with either operation or radium. In this series were 97 cases of inoperable cervical cancer which were radiated only. The results are shown in the following table:

TABLE 1

97 cases inoperable cervical carcinoma radiated only.		
Lost in follow up		3
Dead		77
Less than two years	62	
Two to three years	6	
Three to three and a half years	8	
Four years	1	
Living		17
Less than two years	7	
Two to three years	4	
Three to four years	2	
Four years	2	
Five and a half years	1	
Seven years	1	

Since Table 1 cannot be considered from standpoint of five-year cure we show the following table:

TABLE 2

38 inoperable cervical cancers radiated only.	
Lost in follow up	3
2 immediately, and 1 well at three and a half years	
Dead first year	20
Second year	8
Third year	2
Three to three and a half years	3
Living (5¾ per cent. of 38)	2, at 5½ and 7 years

We thus see that radium alone occasionally cures cancer which is frankly inoperable. The good results are in marked contrast with the cancers of the cervix which were operated elsewhere and sent in to us for postoperative radium. All these cases had been operated by simple panhysterectomy performed by perfectly competent surgeons. In contrast to inoperable carcinoma upon whom no one would undertake operation, in which there were 2 well after five years in the 35 cases followed, not one of the 22 cases which had been radiated a short time after operation survived longer than three years. Table 3 is worthy of study.

TABLE 3

22 cases operated elsewhere. Radiated by me.	
Lost in follow-up	0
Dead first year	10
Second year	9
Third year	2
Three years	1

If radium cures an occasional inoperable cancer it seems perfectly reasonable from the standpoint of pure theory to believe that it should take the place of surgery because it should kill all cancer tissues in the uterus and immediate vicinity, and thus do all that could be accomplished by a radical removal. At the beginning of our work with radium we inclined strongly to this view. We did not feel, however, that it was fair to refuse to do radical operations upon cases which seemed likely to withstand

the operative trauma, and so reserved for radiation only such operable cancers as contraindicated operation because of systemic disease or who absolutely refused operation. There were only 5 such cases which have stood long enough to be studied from the standpoint of five-year cures. One case only survives who is clinically well for six years. We could well exclude, however, from this table one case which died from broken decompensation of the heart one year after treatment while symptom free from cancer. On the contrary, there died from cancer 2 cases three years, and 1 case three and a half years after treatment, although they had been regarded for two years or more as clinically cured.

You see we have cured by radium only 25 per cent. of our operable cases. Others have done far better, and many urge that the results with radium in cases which appear to be operable are so excellent that all surgery should be abandoned. At the present time, however, we do not feel that the results reported warrant this statement. Last fall there were only 167 operable cases in the literature which have been followed for a five-year period. The best results in this group were reported by Doederlein in 1922, yet his figures have not had universal acceptance. Certain it is that no others have duplicated his results. Doederlein divided his material into two groups, one which he states were treated completely, and the others which left before they finished all the treatments that his staff considered necessary. He reports 80 per cent. cures in 43 operable cases which were completely radiated and 41 per cent. of the 34 operated cases which were incompletely radiated. His combined figures total 77 operable cases, with 65 per cent. of five-year cures. The next best series is that of Ward and Farrar, who reported their results in the summer of 1925. They treated 18 cases with 50 per cent. of five-year cures. Ward and Farrar's work is most clear and convincing. Certain it is that their cases were handled in a manner worthy of imitation. They were disturbed as little as possible. Their strength was fortified with tonic treatment and repeated blood transfusions, a method which had not been urged previously. Heymann in 1924 reported the work in the Radium Hemet, the cancer institute of the Swedish government. His

work also excited a great deal of interest, since it is also most thorough and convincing. All the cases were brought back by the Swedish government for repeated examination and were examined personally by Heymann. In the 505 cervical cancers which he treated during 1914 to 1921 inclusive, there were 19 operable cases, only 8 of which, or 40.5 per cent., were cured five years. Yet his results must be disappointing in that he offers hope to but 40 per cent. of operable cases in a city where surgery for operable cases had been abandoned because of the excellence of the Swedish Government's radiation; also disappointing because of the fact that he cured for five years 16.6 per cent. of the 181 inoperable cases and borderline cases of the same series. Bailey and Healy in 1923 reported five-year results in 11 early operable cervical cancers treated in the Memorial Institute in New York City. Three, or 27 per cent., were alive and free from evidence of cancer for five years or more. The percentage of cures, however, is probably greater than this figure, since there were 3 deaths from intercurrent disease and one following operation in another clinic during the period of the follow-up. If we deduct the 4 cases just enumerated from his total, the figure remains as only 40 per cent. This report is of interest since the radium equipment of the Memorial Institute is well known and unsurpassed by that of any clinic in the world. Clark and Bloch reported their results in 1924. They have five-year cures in 5, or 27.2 per cent., of 22 operable cases in the University Hospital in Philadelphia. Clark's report is interesting because this surgeon has abandoned the operative treatment for radium in spite of the fact that he has living but 27.2 per cent. of his operable cases which were treated with radium. Others have reported smaller series. Schmitz in 1924 reports 18 cases, with 9 cures, or 50 per cent.; Seitz in 1922 reports 8 operable cases, with 4 cures; Beuttner in 1923 reports 9 operable cases, with 4 five-year cures.

Because no others have had as good results as Doederlein in spite of the fact that some used the same technic and also gave blood transfusions and had other refinements in technic for the routine after-care of patients, we feel for the present we

will not tabulate them. Exclusive of Doederlein's series there were reported up to last fall only 90 cases of operable cervical cancers that were not operated, but were radiated. These are the cases of Seitz, Beuttner, Heymann, Bailey and Healy, Clark, Schmits, and Ward. Thirty-six of these, or 40 per cent., are five-year cures. If we include the cases of Doederlein, there are 167 cases with 86 cures, or 51.5 per cent.

It seems perfectly fair to argue that since there are only 90 cases in the literature where radium was used rather than radical surgery for the treatment of early or operable cancers, with resulting cures in 36 cases, or 40 per cent., there is no evidence to determine whether radium or surgery at the present time is the method of choice. The combined cases of the men well known personally to me who have reported their results, together with mine, total 71 together with 26 cures, or 36.6 per cent., after making all deductions for lost cases and death from intercurrent disease during a period of five-year observations. On the contrary, we have collected 708 cases of truly radical surgery with 339 five-year cures, or 49 per cent., after modern radical operation in cases of Wertheim, Faure, von Franque, Bumm, Ries, Sampson, Peterson, Cobb, and my own. For these reasons we do not feel that we personally are warranted in giving up truly radical surgery for radium, especially if we combine truly radical surgery with preoperative radiation and follow it with the deep *x*-ray.

One may argue that radium treatment has many advantages over operation. It carries little mortality; there is practically none in the operable group. It does not involve a prolonged hospitalization, nor cause great pain, all of which surgery does do. As a result of our own observations, however, we believe that those who survive the truly radical operation are far more likely to escape a cancer death, and that those who die from the operation are saved the more hideous cancer death. Nor are we from our own experience fully persuaded that there are more distressing sequelæ of operation than of radiation, especially if you limit your surgery to the very early cases and do not attempt to operate anything in the borderline group. Up to

the present time we have done 49 radical operations for cervical cancer, with a mortality of 4, or 8 per cent. This includes cases which were primarily operable, and those which were inoperable when first presenting, but which appeared to be made operable by radium. For purposes of discussion these cases should be separated, since it is debatable at the present time whether it is of value to operate cases which first presented as operable, but which were made operable by radium. Of our 16 primary operable cases which have survived five years, there are 8, or 50 per cent., which remain well and cured. Of the series of 25 cases operated between March, 1916 and March, 1924, 1 was lost from the follow-up when two and a half years clinically well, and 1 died from an intercurrent stroke one year after operation. Four died from operation and 5 died from cancer, 1 each at six months, ten months, one year, one year, and three and a half years. Fourteen are still living for periods between nine and two years. Judging from the fact that 4 of the 5 operated cases that subsequently died from cancer succumbed during the first year, it seems reasonable to believe that nearly all of these 14 living cases are cured. The majority of these early operable cases had had preliminary radiation. We do not know its value, but feel at the present time that if radium is good and radical surgery is good, the combination is worth trying *if* the radium is given before operation. Our series is too small to permit other conclusions than that there remained cured for five years one-half of the 16 cases which were operated, and that in this series we had all of our operative deaths. This supports the long-established view that mortality is reduced by improvement in technic and greater familiarity with the many steps of the operation. At the present time our individual experience warrants our operating, after preliminary radiation, all the truly operable cases that are good risks, and by treating all others with radium. We are uncertain what to do with the inoperable cervical cancers which remain cured by radium for a period of one or two years and in whom appears a return of the cancer in the vaginal vault. Just now we are operating such cases, feeling that it is their only chance to escape from the disease. While

we have 1 case which remains cured for six and a half years, we have had many disappointments.

The case we presented today appeared to have a rather late operable growth when she came into the hospital several months ago. Before instituting any treatment she was transfused and her blood brought up to 70 per cent. hemoglobin and 4,400,000 red blood-cells. The white blood-count fell to normal. The cervix was exposed and a cautery knife was introduced into the cervical mass to make a cavity in which to introduce the mushroom-shaped container for radium. A tube containing 60 mc. was placed in the stem and 70 mc. in four small tubes were arranged in the cap to cross-fire through the vagina. The margins of the growth were needled with seven bare tubes of a little less than 1 mc. each. At this time a small projecting point of the cervical mass was removed with the cautery knife for biopsy. It showed squamous-cell epithelioma of the transitional cell type. Radium was given for a dose of 3200 mc. hours, 2500 of which was obtained from the bomb. She was sent out from the hospital on a nourishing diet and given tonic treatment. Five weeks later she entered the hospital and was again transfused preliminary to operation. At that time the cervical mass had shrunk greatly in size and no longer presented evidence of an infected ulcer. Removal of the cancerous mass was rather difficult, especially in that it was not easy to separate the ureters. After the urinary tract had been separated, the bladder from the uterus and upper vagina, and the ureters from the underlying tissue throughout their entire course in the pelvis, the dissection proceeded down, removing in one piece the fat and lymphatics from the greater vessels, the uterus, round ligaments, tubes, ovaries, parametrium, and half the vagina The pelvis was not drained. All the bleeding points were ligated with fine catgut and the case well peritonealized from above. She ran a low-grade temperature for fifteen days following the operation and was discharged from the hospital after twelve days of a temperature-free convalescence. The pulse remained at 80 after the ninth operative day. The temperature was low grade in type, crossed 38° C. but once, running for the average about

37.6° C. Six months later her pelvis remains soft and free and the woman appears in excellent condition. The microscopic sections showed that there had been an extension of the carcinoma into the vagina, a condition the importance of which is not ordinarily recognized.

In conclusion, I wish to repeat that, as a result of our individual experience, we believe that at the present time, two to four weeks after preliminary radiation of about 3000 mc. hours, we should remove by a truly radical dissection all cervical carcinomas that appear limited to the cervix if the patient is a good operative risk; that we should treat all others by radium, and do all that is possible to discourage the ordinary panhysterectomy in the treatment of cancer of the uterine cervix.

CLINIC OF DR. HOWARD C. NAFFZIGER

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CEREBRAL ANEMIA AND SURGICAL RISKS

CEREBRAL circulatory disturbances in the aged and in those with diseased cardiovascular systems appear frequently as the dangerous complications in surgical cases. The clinical picture varies widely, depending upon the degree of anemia, and whether it affects the brain as a whole or some particular area of it. Extreme anemias may cause profound collapse, with the usual picture of shock. Others may show delayed recovery from the anesthetic. Drowsy, confused, and disoriented mental states may be seen after operation. Occasional aged individuals may be demented. Hemiplegias are sometimes seen as a postoperative complication and usually are diagnosed as due to embolism. Sudden elevation of the patient's head after a Trendelenburg position may be followed by alarming circulatory and respiratory changes. Shock may appear with apparently little provocation and slight loss of blood. Such occurrences may be seen after anesthetics of all types.

In the interpretation of such pictures, while many factors may be involved, cerebral anemia is the most alarming feature. A consideration of the manifestations of cerebral anemia in cases that are not surgical aids in the interpretation of these states.

In young and supposedly normal individuals an inadequate cerebral circulation may be followed by blurred vision, tinnitus, dizziness, fainting, or convulsions.

Other individuals, especially the old, are prone to cerebral accidents which cause more localized cerebral anemias, such as rupture of a vessel, embolism, or thrombosis. In each the effects

produced are referable to the particular part of the brain which is deprived of blood-supply.

Another group is of exceptional interest. This includes those who have transient hemiparesis, hemiplegias, numbness, aphasias, etc. The same person may have many such attacks. About these a considerable literature has grown up. Excellent articles on the subject have appeared by Russel, Osler, Inman, Parker, and many others. As causes of these attacks arterial spasm, or intermittent closing of cerebral arteries, has received most attention as the immediate cause. Such contentions are supported by experimental proof that arteries of the brain are capable of contraction as a result of mechanical, thermal, chemical, and electric excitation. Nerve-fibers have been described in the walls of cerebral vessels. Certain associated clinical phenomena give weight to the likelihood of such pathologic occurrence. Osler has reported a case of Raymond's disease which showed at various times spasms of vessels in the lower extremities, and at other times symptoms presumably due to spasms in cerebral vessels. Also in migraine, spasm of retinal arteries is not uncommonly seen.

Unquestioned evidences of impairment of brain circulation appear frequently in persons who do not fit into any of the above groups. Their symptoms cannot be explained by vessel rupture, embolism, or thrombosis, nor is it necessary to presuppose a vessel spasm. Our attention was focused on another possibility by observations on cases of hemiplegia admitted to the University of California Hospital. We were impressed by the number in whom a hemiplegia came on during sleep or while the patient was at rest. Most of these were admitted with a diagnosis of cerebral hemorrhage. Many of them had been at work up to the preceding day. It is difficult to conceive why a person who withstood the fluctuations of blood-pressure occurring with physical labor should rupture one of those vessels while resting or asleep. It is not a likely assumption. Of the other common causes, embolism and thrombosis are frequently mentioned. In considering these, emboli must have a place of origin. In the absence of diseased heart valves, lung and mediastinal infections

and growths, thromboses in other parts of the body or other discoverable sources, embolism cannot well be diagnosed. Also primary thrombosis in cerebral vessels presumes certain antecedent factors existing either in the blood or in the region at which thrombosis occurred. An investigation of such cases as these at autopsy most commonly reveals sclerosed vessels of minute caliber. The brain supplied by these vessels shows changes dependent upon the degree and duration of the anemia. Emboli or thromboses are rarely demonstrable. Other cases may recover after a hemiplegia coming on under such conditions of rest. In these cases it was evident that we were dealing with localized cerebral anemias. In view of these conditions of occurrence and of the pathology or lack of pathology found, it would seem that a drop in blood-pressure would bring about such a state. Each individual has an optimum of blood-pressure. In the normal person this has a certain level. In the old person with vessel sclerosis their optimum may be something else than a normal pressure. Cardiorenal disease may require or produce another level. To the man with myocardial change a certain pressure level best meets his requirements and his dangers. In the man with narrowed cerebral vessels a certain degree of blood-pressure is required to force the blood through the narrowed channels. If for any reason his blood-pressure falls below the level desirable for him, there will be anemia of the part which this vessel supplies. The fall in pressure may result from a variety of causes. Myocardial weakness, the shock of an operation or accident, or overzealous and unwise attempts of the physician to lower his pressure may be responsible for his pressure being brought below his optimum. General cerebral anemia may occur, or if some one vessel is more sclerosed than another, that part of the brain alone may be affected. Internists are well aware that certain elevations of blood-pressure are protective and that some patients do poorly when their blood-pressure is lowered.

Such experiences have led us to believe that in the aged and those with diseased cardiovascular systems, cerebral anemia is prone to occur with slight provocation, and when for any reason

the blood-pressure level falls below their optimum. Measures are necessary to avoid such drops. Properly directed treatment requires prompt recognition of the condition. The following case represents the effect of a marked drop in pressure in cardiorenal disease:

H. C. R. University of California Hospital, No. 53,679.

Admitted for tonsillectomy. Blood-pressure 192/120. Tonsillectomy under ether. Some difficulty in controlling bleeding and some bleeding continued during the afternoon. It was not great in amount and did not affect the blood-pressure. Its continuance made suture of the pillars advisable. In the afternoon ether was given again and the suture performed. At 9 P. M. blood-pressure 130/100. At 3.15 A. M. blood-pressure 80/60. Patient unconscious and skin cold. Cheyne-Stokes respiration. High shock blocks were used to elevate the foot of the bed. Caffein was given. At 4.30 A. M. blood-pressure 110/60, at 8.15 A. M. blood-pressure 150/95. At this time consciousness had returned. Blood-pressure returned to and remained at its preoperative level and without further symptoms.

In this instance, regardless of the numerous factors which may have contributed to their occurrence, the unconsciousness, collapse, and Cheyne-Stokes respirations were due to a fault in the cerebral circulation.

On various occasions, such as genito-urinary, pelvic, and Kraske operations in elderly persons, collapse with respiratory and circulatory changes has been seen. These changes are more apt to occur when the patient is suddenly restored to a horizontal or head-up position after a Trendelenburg. Prompt resumption of the head-down position is the best treatment. Severe operations and a Fowler position in bed are unfavorable combinations in the old, as in the following:

Mrs. F. C. Children's Hospital.

Final diagnosis: Papillary adenocarcinoma of cecum. Chronic arthritis. Eczema. Secondary anemia.

This patient, eighty years of age, had lost 25 pounds in six months, and developed a moderate secondary anemia with a mass in the right lower quadrant and signs of partial obstruction.

Blood-pressure 145/90 and heart slightly enlarged to the left. Two weeks before entry had some pain on the left side of the head, but was not dizzy, had no fall, and there were no peripheral disturbances.

Under gas-oxygen with a small amount of ether, and with the Trendelenburg position, the surgeon performed a resection and anastomoses. The operation was well and quickly performed. Very little bleeding. The patient was returned to bed and placed in a semisitting position. Remained drowsy and confused. Did not clear entirely from the anesthetic, and in the first twelve hours developed a gradually increasing left hemiplegia. When seen in consultation the systolic pressure was 80. No response to treatment. Exitus. Autopsy not obtained.

In such a case the gradual deepening of symptoms indicated progressive general cerebral anemia which became more marked in the one hemisphere, presumably from greater scleroses of vessels on that side. Frequent observations of blood-pressure during the operation, administration of fluids, very gradual lowering from the Trendelenburg position, and a head-down position in bed might have contributed to a favorable outcome.

When cerebral anemia occurs as readily without operation as in the following case the dangers of surgical procedures are apparent:

A man of fifty-five was seen in consultation in hospital on account of a hemiplegia. Significant points in the history were as follows:

The patient was an attorney, very actively engaged in his profession and associated in many undertakings which at that particular time involved a great deal of work and worry. It was found on later inquiry from a physician whom he had consulted at that time that he was carrying a blood-pressure of 250. Upon the physician's advice he discontinued work and took a vacation. After a train trip of several days he seemed somewhat relaxed, and told his wife that he felt entirely "let down" and tired out. Upon arriving at his destination he went to a hotel, and during that night his wife was awakened by his stertorous breathing. He was taken to a hospital, and when

seen in consultation he was found to be unconscious with stertorous breathing, nearly abolishd reflexes, and a blood-pressure with a systolic of 170. No focal signs pointing to a localized brain lesion were present. He was still in deep stupor. Measures had already been in mind which could further reduce his blood-pressure. It was advised that, on the contrary, efforts be made which would tend to elevate his blood-pressure. During the next few days as his blood-pressure increased, the patient improved. When his blood-pressure had reached 220 systolic he regained consciousness and progressed to his usual health.

It seems evident that this man could not have had a cerebral hemorrhage or a complete and permanent blockage of the vessels such as would be assumed by a diagnosis of embolism or thrombosis. It is possible, of course, that he may have had generalized vessel spasms, but, in view of his arteriosclerosis and the known drop in blood-pressure, it seems hardly necessary to assume that this need be present.

In those with circulatory impairment, and particularly in the sclerotic, special attention should be given and directed toward the avoidance of drops in blood-pressure. With cardiac decompensation the necessity of treatment toward remedying this is obvious. In others in whom there seems to be proper cardiac compensation, and yet with arteriosclerosis or cardiovascular diseases, special attention should be paid during operation to alterations in blood-pressure and to means directed to sustaining the blood-pressure. Prevention of loss of body fluids and replacement of these fluids as far as possible by fluids under the skin, intravenously, or per rectum, would seem advisable. The position on the table would seem to merit special attention. Cerebral anemia is lessened by a head-down position. In this connection it should be remembered that restorations of the patient to a horizontal or head-up position should be accomplished slowly and with careful observations of blood-pressure at the time. Of other medical means we have relied largely upon caffein, and there is some reason to believe that strychnin may be of value. We have hesitated to use the more powerful drugs such

as adrenalin or pituitrin. It has been our feeling that if the factors which brought about the drop in blood-pressure could be corrected, it would be much better to avoid the use of such vigorous stimulants, not knowing the aftermath they may cause or how they may upset the patient's ability to regain his usual circulatory balance.

In cases predisposed to cerebral anemia surgical risks can be lessened and proper treatment instituted if the condition be kept in mind.

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CONTRIBUTION BY DR. FRANK HINMAN

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AN EXPERIMENTAL STUDY OF THE PATHOGENESIS OF HYDRONEPHROSIS

So far as the minute pathologic pictures are concerned there is no real difference between a hydronephrosis due to complete ureteral obstruction or partial obstruction, nor is there any relative difference in similar stages whether these obstructions are permanent, progressive, temporary, or intermittent. Since the histologic pictures are in every way similar, it is well to confine the discussion of pathogenesis to complete obstruction, and at the outset it is well to define clearly three types of atrophy commonly used in describing changes that follow complete obstruction: *Primary atrophy* is the term used to apply to the atrophy that sometimes follows a complete obstruction without dilatation or distention of the pelvis and tubules of the kidney. It is, more strictly speaking, an anemic and disuse atrophy, and in this sense with respect to the kidney is synonymous with anuria. *Hydronephrotic atrophy* is the term applied to the usual changes following any type of obstruction, the cause of which is necessarily a continued secretion of urine, and is, more strictly speaking, a pressure and anemic atrophy. *Secondary atrophy* is the term that might be applied to secondary changes due to infection, degenerations, or disuse that might follow either one of the above two conditions, but is common in the course of a hydronephrotic atrophy and should be carefully distinguished, as when occurring early in the course of a hydronephrotic atrophy it may lead to the condition being considered as a primary atrophy.

An explanation of the unique condition of pelvic dilatation and the type of parenchymal atrophy (*hydronephrotic atrophy*)

that occurs in hydronephrosis must take into consideration four very distinct problems: The first problem is an explanation of the rare occurrence of primary atrophy with complete obstruction; the second is an explanation of the action of intrapelvic pressure; the third problem is an understanding of the significance of the collateral circulation in the development of the condition; and the fourth problem is the demonstration of reabsorption and the route pelvic contents take when the ureter is completely obstructed.

1. **Primary Atrophy.**—It is repeatedly stated in the medical literature that complete ureteral obstructions lead at once to primary renal atrophy without pelvic or tubular distention, and clinical results of accidental ligature of the ureters have often seemed to support this view. Purposeful ligature of one ureter has even been advocated as the procedure of choice in some pelvic operations in which excision of the lower part of the ureter is required, it being confidently stated that no trouble so far as the kidney is concerned will result therefrom, a primary atrophy being certain to occur. This misconception no doubt has arisen from results of a few earlier experimentations on animals, such as cited by Morris in his book on the kidney, but there is absolutely no support for such a belief in results of more recent experimental work, and clinically there are also certain facts to refute it. Experimental findings in animals cannot be applied too literally to man, as the conditions are not always identical. Calculous anuria differs from an aseptic ureteral ligature. In an extensive experimental study of the results of complete ureteral ligature in the rat, guinea-pig, and rabbit the writer has met with not a single instance of primary atrophy, and in a number of experiments it was never seen with complete obstruction of the ureter in the pig. It has been met occasionally in experimental work in cats and dogs, but in every instance in either animal marked pyelonephritis also was present. Experimentally the chief difference between the results that follow complete and partial obstructions is in the period of time relative to the degree of hydronephrotic change. With complete obstruction there is complete hydronephrotic atrophy on

the average in the rat in one hundred and twenty days, in the rabbit in three hundred days, and in the dog not until after about eighteen months, but in each animal the complete obstruction of the ureter leads eventually to complete disappearance of the renal parenchyma and a large dilated thin-walled sac filled with a watery clear fluid. The result of a partial obstruction is obviously proportional to the degree of obstruction, and with partial obstructions much greater hydronephroses result than with complete obstruction, but eventually there is also complete disappearance of the renal parenchyma. A strong argument against complete obstruction always causing primary atrophy is the fact that it occasionally follows partial obstruction. The only case of primary atrophy seen by Barney was in an animal which had a partial obstruction of its ureter, but here the distinction between primary atrophy and secondary atrophy is paramount. It has also been shown experimentally that there is some difference in the rate of development of hydronephrosis with the ligature high or low on the ureter, the low ureteral obstructions being somewhat slower of development than the high. It has also been found that in those animals in which primary atrophy does occasionally occur it is somewhat more frequent with high ureteral obstruction. The fluctuations of intrapelvic pressure occasioned by ureteral peristalsis may be a factor of their difference. An important consideration with respect to the incidence of primary atrophy is whether the kidney was the seat of some pre-existent disease or not, as primary atrophy would be expected to occur somewhat more frequently in a diseased kidney whose ureter was suddenly obstructed than in a healthy kidney. These facts with respect to primary atrophy experimentally produced lead to the conclusion that it is quite analogous to calculous anuria seen clinically, and that the real factor is sudden anuria, for which there may be many factors that might be responsible. In a study of calculous anuria it is known that the kidney may suffer reflex vasomotor spasms that are in many respects similar to the inhibitory reflexes that result both unilaterally and bilaterally from irritation at the level of the bladder as well as the ureter, the inhibition

following ureteral catheterization being a common example. Primary atrophy, therefore, in this sense is primarily a vasomotor reflex or spasm with anuria, and where this persists there will result an anemic and disuse atrophy. But the complete obstruction of the ureter does not cause the atrophy, but the anuria, a reflex that rarely occurs in experimental animals. The conclusion that complete ligature of the ureter in man leads to primary atrophy is based largely on clinical findings. There being no immediate effect noted in the way of pain or infection, one naturally has supposed that the kidney has ceased to function. This would not necessarily follow, as it is well known a hydronephrosis develops gradually, and in those cases clinically recognized there have often been no symptoms indicative of a kidney condition. It of course would be impossible to make a urologic study in a kidney with a ureter that had been tied at operation, subsequently to determine whether the kidney was undergoing hydronephrotic or primary atrophy, and it could well undergo a complete hydronephrotic atrophy without the patient being aware of this type of destruction.

2. **Intrapelvic Pressure.**—It is known that the intrapelvic pressure differs from the secretory pressure of true glands such as the salivary glands. These latter, upon stimulation of their secretory nerves, can be made to show a pronounced increase of secretory pressure, whereas attempts to increase intrapelvic pressure by stimulating any known nerve supply to the kidney or even to prove a secretory nerve supply to the kidney have utterly failed. Intrapelvic pressure may be modified somewhat by the conditions producing diuresis, but is most dependent upon blood-pressure. It bears a certain relation to the amount of renal mass. As has already been shown, with complete obstruction the time period required for complete hydronephrotic atrophy varies with the amount of renal mass (rat, four months; rabbit, ten months; dog, eighteen months). Intrapelvic pressure has long been held to be the basis of hydronephrotic atrophy, and, if this is true, it should be possible to increase or decrease the rate of development of hydronephrosis by increasing or decreasing permanently the amount of intrapelvic pressure.

If one takes the dog as an example, upon complete ureteral obstruction fluid in a manometer will rise to between 70 and 90 mm. mercury, about which point it will fluctuate for several hours and then gradually fall. If one takes a series of animals with complete ureteral obstruction and measures the pressure under which the fluid in the tied-off pelvis exists at varying periods from the time of obstruction, it will be found that there is considerable variation for the same period of obstruction, but that they show a gradual and progressive fall up to the time complete hydronephrotic atrophy occurs, when the fluid is present in the pelvis under no measurable pressure. In a series of such experiments it will also be found that there is considerable difference between pressure as present in any hydronephrotic sac and the pressure to which this hydronephrosis can raise the column of fluid after the obstruction has been relieved. The former may be called static pressure and the latter secretory pressure, but though there is considerable difference and variation, fundamentally secretory pressure never greatly exceeds the static pressure found before relief of the obstruction unless the kidney has been permitted to undergo a period of repair, with which it is found that secretory pressure will progressively and gradually rise. In this way secretory pressure is really a very good functional test of a kidney. A deficient kidney will show a low secretory pressure as compared to a more efficient kidney. In a study of secretory pressures there are many factors that may modify it, and the inhibitory ones above mentioned are particularly active, so that in an experimental animal reflex influences of inhibition are sometimes prohibitory so far as experimental results are concerned.

With respect to the effects of an increase of blood-pressure, an increase of blood flow through the kidney, and an increase of the intrapelvic pressure on the rate of development of hydronephrosis, several different methods are applicable. If intrapelvic pressure is the chief factor in the development of hydronephrosis, prolonged diuresis should definitely increase this rate. In a series of experiments on white rats which were given relatively enormous quantities of fluid by intraperitoneal injections

over prolonged periods in conjunction with the better known diuretics, a prolonged and excessive diuresis was produced.[1] It was found that this diuresis affected in no way the rate of development of hydronephrosis. In another series of experiments on the effect of splanchnotomy,[2] which is known to produce unilateral diuresis with an increased blood-flow, an increased intrarenal pressure and a consequent increased intrapelvic pressure, the results show that lateral splanchnotomy had absolutely no effect on the ordinary rate of development of hydronephrosis. In a third series of experiments the effect of partial ligature of the renal vein on the rate of development of hydronephrosis was studied.[3] It is known that if the renal vein is partially obstructed, intrarenal pressure will rise until with an increase in obstruction it equals that of the renal artery, when secretion, of course, ceases. With lower grade obstructions of the vein there is a slowing of the blood-stream, a relative oliguria, but a very definite rise of intrarenal pressure and secretory pressure. It was found experimentally that partial obstruction of the renal vein increased somewhat the rate of development of hydronephrosis up to about the twenty-first to twenty-eighth day in rabbits, after which it assumed its ordinary rate of development as seen with simple ureteral ligature. This finding will be more fully explained in conjunction with experiments cited below with respect to the significance of the venous collateral system to the kidney. So far as increased blood flow and increased secretory pressure are concerned the above experiments fail to show any effect on the rate of development of hydronephrosis.

In another series of experiments with white rats, to test the effect of a decrease of pressure, fluids were limited to the point of water starvation for prolonged periods, producing a marked oliguria with a lowering of the secretory pressure, and it was found that there was practically no change in the ordinary rate of development of hydronephrosis, except in a few rare instances in which there seemed to be a definite hastening of the hydronephrotic atrophy for the period studied.[1] The secretory pressure in another series of experiments was lowered by partial

obstruction of the renal artery,[4] producing a slowing of the blood-stream and an oliguria with diminution of the secretory pressure, and it was found that this procedure markedly hastened the rate of development of hydronephrosis. As already mentioned, partial obstructions of the ureter do not give as great intrapelvic pressures as complete obstruction, and yet with partial obstructions there is a much more pronounced pelvic dilatation though the rate of development is slower.

These many experiments all point to the fact that intrapelvic pressure, though essential, is not the principal factor in the development of the peculiar condition of hydronephrotic atrophy.

3. **The Significance of the Venous Collateral System.**—Earlier experimenters (Lindemann) noted that in those animals which showed hydronephrotic atrophy there was a well-developed venous collateral system, whereas in other animals which showed a primary or secondary atrophy the collateral system of vessels was poorly developed or practically absent, which led to the conclusion that the perirenal system of vessels is the essential factor in the development of a hydronephrosis or atrophy, the former developing where this system is well developed and the latter when it is poorly developed or absent. This conclusion has been confirmed by several observers since. It is possible experimentally to test this view. In a series of rabbits all of the perirenal vessels were carefully ligated and divided and the ureter completely obstructed.[5] It was found that in every instance hydronephrosis developed, but that it seemed to develop at the ordinary rate for the first twenty-one to twenty-eight days, after which there was an evident hastening in the rate of development, though not great. The importance of the perirenal system can be fully realized by watching the effects of ligating one branch of the renal vein with complete ureteral ligation. A series of such experiments demonstrated that there was no change in the ordinary rate of development of hydronephrosis, but that the perirenal system established a collateral circulation to compensate for the loss which resulted from the ligature of one branch. In fact, after a period of two to three weeks in which this collateral system might become thoroughly

established it was found that the other branch could also be ligated without changing the ordinary rate of development. In other words, perirenal veins are capable because of the free venous anastomosis in the kidney of taking up the function of the renal vein.* The results of partial obstruction of the renal vein with complete ureteral ligation have been mentioned above, and when this procedure is combined with complete ligature of the perirenal vessels in a series of animals, it is found that the rate of development of hydronephrosis is hastened uniformly up to the fourth week, after which there is a marked progressive secondary atrophy, an atrophy that might easily be mistaken for a primary one in animals with prolonged obstruction.

The conclusions to be drawn from these several experiments is that the perirenal system acts purely as collateral, and that it takes from twenty-one to twenty-eight days for this to become fully established, and, so far as primary atrophy is concerned, whether the perirenal system of vessels is well or poorly developed is immaterial, but that with a scant capsular supply secondary atrophy in the late stages is common.

4. **Pelvic Reabsorption.**—It is at once obvious that any explanation of the mechanism of hydronephrosis must account for renewal of the pelvic contents, which necessitates some kind of reabsorption. Anatomically, with progressive hydronephrosis Henle's loops quickly disappear, and Henle's loops have ordinarily been considered to be the principal portion of absorption of the renal tubule. Studies with intravital stains in progressive hydronephrosis[6] show that the proximal convoluted tubules, those next to the glomeruli, persist longest, and this is just what would be expected in view of this portion of the tubule being directly supplied with blood from the glomerulus. Studies on repair hydronephrosis show that these group areas of tubular

* The cat is a probable exception, for the reason that the venous backflow from the cat is peculiar, there being a well-marked superficial system of veins on the kidney surface draining back to the pedicle, an anatomic condition which we have not seen in any other animal studied. The cat, in consequence, does not have the well-marked capsular blood-supply as other animals whose superficial renal veins drain back in the cortex to the deeper system.

preservation may undergo marked repair with relief of obstruction.[6] Anatomically also in early periods of hydronephrosis there is a uniform dilatation of the whole tubule, but very soon there is a collapse of the deeper elememts and still later a collapse of the whole tubule. It is extremely difficult to inject the tubular system, and pressures to effect this must be exerted suddenly in high degree for a short period.[7] Otherwise extravasations or no injection occur. On the other hand, we[8] have placed rubber bands about the solitary papilla of a unilobed kidney (rabbit) and have noted that there has been uniform dilatation of the single tubules above the obstruction. But these obstructions have been present for relatively short periods, about seven days, and it is probable that were it possible to place a complete obstruction on any of the collecting tubules for prolonged periods an early atrophy would result. Studies of the contents of hydronephrotic sacs at different periods show that these contents are not cumulative or stagnant pools, but that they are akin to fresh-water lakes, being continuously renewed by active secretion above. Tubular reabsorption alone would fail to remove non-threshold substances. The placement of phenolsulphonephthalein in a normal pelvis with the ureter tied shows that it completely disappears in anywhere from two to four days.[9] These facts signify some outlet for the pelvic contents with complete ureteral obstruction, but it is apparent that such an outlet by way of back-flow up the individual tubules with reabsorption is insufficient to explain them. Experimentally it is possible to demonstrate that a back-flow from the pelvis directly into the small venous radicles at the apices of minor calices under pressures always well below secretory pressure occurs.[10] This can be demonstrated in living and cadaver kidneys. As beautiful an injection of the venous system is possible by way of the pelvis as by way of the renal vein itself, and no point of extravasation, tear, or injury can be discovered on subsequent examination of the specimen. The condition is analogous to the drainage from the anterior chamber of the eye into the canal of Schlemm. The occurrence of such pyelovenous back-flow accounts for the ability of a kidney with its ureter

completely obstructed to continue active secretion; for the finding that the pelvic contents are freshly renewed and similar in concentration and elements present to what such a kidney secretes immediately after relief of obstruction, and also for the ability of a kidney to undergo repair after relief of complete obstructions in spite of the fact that the kidney possesses no nutrient blood-vessels.

A consideration of the discussion of the above four problems emphasizes the relative significance of pressure, anemia, degeneration, and disuse in the development of hydronephrotic atrophy. That anemia is the principal factor may be further demonstrated by the effect of ligating one branch of the renal artery and the ureter completely in the development of huge pelvic diverticula.[11] That disuse in the later stages becomes a factor of moment is also demonstrable by the results that follow transplantation of the ureter into the duodenum in which a pure disuse atrophy may be demonstrated.[12] Pressure undoubtedly is the primary factor. The pelvis dilates, the tubules dilate, and each in turn has a pressure effect upon the venous radicles with a consequent congestion, and these three pressure factors have their effect upon the arterial supply, diminishing it.[13] There is a definite group distribution in the magnitude of these various factors, and a group injury with group preservation is the result. Those groups which receive the largest and most direct blood-supply are the ones which persist longest and continue secreting against the intrapelvic pressure, which gradually diminishes as secretory activity diminishes, but is possible of continuation because of the ready back-flow of pelvic contents into the small venous radicles.

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CLINIC OF DRS. ALANSON WEEKS AND LEROY BROOKS

ST. LUKE'S HOSPITAL

STRICTURE OF THE RIGHT HEPATIC DUCT

THIS woman is forty-one years old and has borne 5 children. She gives a history of having had the usual diseases of childhood, but not typhoid fever.

In 1908 she had attacks of excruciating pain in the upper abdomen, in the midline, radiating through to the back and both shoulders, with equal severity. She was colicky and deeply jaundiced. She had many attacks similar to the above until a cholecystectomy was done in Canada in 1917, when she was relieved of the pain until October, 1923, but the jaundice persisted, although it was lighter in color. The stools had never been clay colored to her knowledge, but during these years the urine had been dark, and became darker than usual following each attack of pain.

In October, 1923 she had severe colicky pains similar to the ones before the operation. The jaundice became deeper in color during this time, and she was nauseated almost constantly, but never vomiting. This condition has recurred numerous times, and after a rather severe attack she has been admitted to St. Luke's Hospital.

She comes to us very deeply jaundiced, but the stools are not clay colored at any time. The urine is darker than normal. The patient has never been constipated, and she tolerates all foods except fats. She complains of an itching of the skin which becomes more annoying after an attack.

Examination reveals a well-developed, very much jaundiced young looking woman, not in pain. The general physical

examination is negative except for the jaundice; pain on pressure in the right upper quadrant and a well-healed postoperative scar in this region.

Blood-pressure is 118/65.

Laboratory Report.—Hemoglobin, 60; red cells, 3,700,000; white blood-cells, 8000; polymorphs., 75; lymphocytes, 27.

Fig. 137.—Stricture of the right hepatic duct.

Blood Wassermann negative.

Coagulation time, five minutes.

Bleeding time, four minutes.

After injection of 5 c.c. of 10 per cent. calcium chlorid solution on three consecutive days the coagulation time was reduced to four minutes.

Blood-sugar, 100; urea nitrogen, 19.02; uric acid, 3.01 mg.; creatin, 1.09 mg.

Biochemist reports no retention to contraindicate an operation.

Urine.—Specific gravity, 10/20; reaction, acid; albumin, 2 plus; mucus, 2 plus; hyaline casts, 2 plus; white blood-cells, 2 plus.

Tests made after the patient had a rest in the hospital and before she was operated upon showed no more albumin or casts in the urine.

x-Ray examination of the gastro-intestinal tract, including plates for stones, was negative.

We have made a preoperative diagnosis of common duct stone of the ball-valve type, or cicatricial stricture partially obstructing the common duct.

We will make a high right rectus gall-bladder incision. There are many adhesions of the omentum, stomach, hepatic flexure of the colon all along the edge of the liver to the old wound, with the edge of the liver attached to the anterior abdominal wall. These are separated with very great difficulty. The foramen of Winslow is finally clear and the gastrohepatic omentum is isolated. The common duct is perfectly smooth and shows no adhesions where one would expect to see them if the cystic duct had been tied off in its usual location at the time the gall-bladder was removed. The common duct is separated and found to be the size of an ordinary little finger; it is not tense with bile. It is opened and a probe is passed easily into the duodenum. On opening the common duct more toward the liver the mouths of the right and left hepatic ducts can be seen. A probe is passed easily far into the left hepatic duct, but can only be passed in the right hepatic duct as far as its actual entrance into liver tissue. Where the probe stops in the right hepatic duct there is a stricture which we believe was caused most probably by the removal of the cystic duct at this unusual place. There can be no other reasonable explanation of a stricture of this duct at this place. After considerable effort a fine probe is passed through this stricture, and then a larger and a larger one. We continue to dilate until a pair of uterine dressing forceps can be passed through the stricture, dilating it very considerably. This dilatation seems to us to be the only thing which can be done, inasmuch as the stricture is

right at liver tissue, and we are hoping that so wide a dilatation may result in a cure. No stones are found in any part of the ducts. The common duct is closed with two layers of chromic catgut, as there is no indication to drain it. A rolled rubber drain is passed to the site of the opening.

It is evident from these findings that the clinical picture is easily explained. The patient never had any clay-colored stools because the left hepatic duct was emptied through the common duct into the bowel. The jaundice was constant because of the interference at practically all times of bile leaving the right side of the liver through the stricture of the right hepatic duct. The stricture was evidently never completely closed, and when either inflammation, a piece of mucus, or otherwise, closed it, the patient suffered her attacks of colicky pain.

Postoperative Notes.—The rolled rubber drain was removed on the third day and there was never any leakage of bile. The wound healed by first intention. The convalescence was uneventful, and the patient left the hospital eighteen days after the operation. The jaundice had grown very much lighter, and according to the statement of the patient it was lighter than it had been since 1908.

One month following her discharge from the hospital the patient came to the office decidedly jaundiced again, but she has been feeling much better since her operation, in fact, particularly well, and as there does seem to be some improvement from her old attacks of pain, she was advised to continue without further effort at dilating the duct.

One year after she left the hospital she reported in the office again. She stated she had a slight amount of jaundice all the time, but that it was much less than formerly. Her attacks of pain are also less. The patient had gained 10 pounds in weight and seemed reasonably contented.

RUPTURED DIVERTICULITIS WITH GENERAL PERITONITIS

THIS man, aged forty-two years, gives a history of awakening yesterday morning with pain in the abdomen which was cramp-like in character. He had a similar attack some time ago, but he was able to attend his routine business as usual. He ate three meals yesterday. The pain became worse and seemed generalized more in the right side of the abdomen than otherwise.

He awakened in the middle of last night with nausea and a desire to vomit, which gradually became so bad that he emptied his stomach of a great deal of fluid and food. The pain seemed to be less this morning; however, he called Doctor Kay, who suspected at once an acute abdominal condition, and sent the patient to the hospital.

This morning his white count showed 23,000 with 88 per cent. polynuclears. When Doctor Kay examined him, the patient complained more of pain in the right lower quadrant and in the region of the bladder. When we both examined him an hour ago there seemed to be more guarding over the left than the right lower quadrant, and nothing definite could be made out by rectal examination except a general tenderness.

We agreed that the most likely condition was an acute appendix, with a possible rupture and spreading peritonitis; but on account of the pain and guarding over the left lower quadrant diverticulitis should be considered.

A long, right rectus incision is made and the peritoneum opened. Considerable free, yellow fluid is seen in the abdomen. The bowels, including the cecum and small bowel, are all markedly injected, and as we deliver the appendix it is seen to be covered at its end in fibrin, but looks no more involved than the rest of the bowel, except for the fibrin on the tip. The appendix is removed, and now, as the bowel is walled off, the pelvis is seen full of fibrin-filled fluid, and a search is made for the more likely cause. In looking for diverticulitis in the bottom of the pelvis a thickened mass in the fat of the sigmoid, in near conjunction

with the rectum, is felt, and one can now see a greenish-brown area the size of a 5-cent piece in a fat tab—a ruptured diverticulum.

Because of the already well-advanced general peritonitis we believe it unwise to attempt any radical procedure, and we will now place a rolled rubber drain in the bottom of the pelvis. From former experiences it is preferred that this patient risk a fecal fistula rather than the danger of more operative work in the presence of so much inflammation. The cecum is tacked by two stitches at its white line to the peritoneum just above the drainage rubber in the wound. This is done in case it is decided to do more radical work about the sigmoid. You see there are no markedly distended coils of bowel, and therefore we believe it safe to wait, should we wish to drain the jejunum if the paralysis of the bowel becomes more complete and dangerous.

We will treat this patient as we now routinely do any one who has a general peritonitis, with the exception that no fluid will be given by bowel, because we have had the unhappy experience of having the glucose and bicarbonate drip come through one of these ruptured diverticulæ with considerable force two days after an operation. He will receive 1000 c.c. 10 per cent. of glucose solution intravenously each morning for fuel and food, and from 1000 to 2000 c.c. normal salt solution into the muscles of his thighs, each evening, to overcome the viscosity of his blood, that his tissues may receive a proper amount of oxygen, and that he will have sufficient fluids to secrete his toxins. The amount of fluid and food he will receive will, of course, depend upon his condition from day to day. He will be given absolutely nothing by mouth or bowel until it is evident from a renewed peristalsis that his body has overcome the peritonitis.

Postoperative Note.—Normal peristalsis started in this patient five days following operation. The wound drained moderately for two weeks. He developed a pneumonia in the right lower lobe eighteen days after operation, which cleared up rapidly.

At the present time the patient is in excellent health.

LARGE CONGENITAL SLIDING HERNIA OF THE CORD

THE patient is a baby boy, born five hours ago; a rapid, normal delivery. The family history is without interest except for the fact that this is a second child; the first one, born two years ago, being normal. Excluding the hernia, this child is apparently normal in every particular. He cries lustily, is of good color, and weighs 6 pounds, 11 ounces.

You will notice protruding from the umbilicus instead of a normal cord a large mass covered by the usual grayish membrane

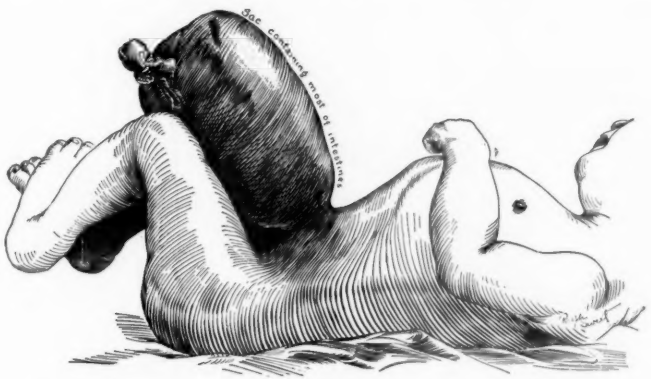

Fig. 138.—Large congenital, sliding hernia of the umbilical cord.

of the cord. It is about 4 inches in length, $2\frac{1}{2}$ inches in diameter, and is cylindric in shape. The veins of the cord can be seen running up one side, and darker masses are visible moving within the more or less translucent membrane. A gurgling can be felt, indicating that the membrane of the cord undoubtedly contains intestines which cannot be returned through the ring, which is normally constricted at the umbilicus. At the center of the outer end of the tumor you will note where the usual sized cord was tied and severed. You will also notice

that this baby's abdomen is concave instead of being quite convex, as is normal at this age, due, no doubt, to the fact that most of the contents of the abdomen are in this sac.

The baby has been anesthetized with ether. The abdomen and hernia are painted with 1 per cent. tincture of iodin.

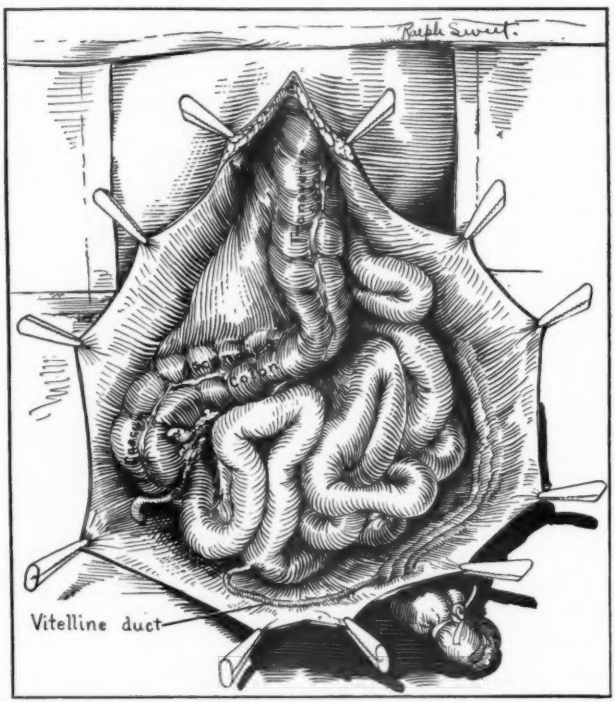

Fig. 139.—Large congenital, sliding hernia of the umbilical cord with sac open.

The skin is split at the midline, beginning at the edge of the ring above, for a distance of $1\frac{1}{2}$ inches. The ordinary constricting connective tissue is cut at the ring and the grayish membrane covering the mass is split to the distal end in continuation with the incision in the skin and the fascia above. The sac is opened to the top with great care, and is seen to contain nearly all the

large bowel from the cecum over to the splenic flexure, and practically all the small intestine with its mesentery; and much of the postparietal peritoneum from above in the form of a sliding hernia. From the level of the umbilicus down the peritoneal cavity seems to be normal. Here can be seen a white cord reaching from the small intestine near its termination in the cecum out to the end of the pouch, probably a Meckle diverticulum, which is tied near the intestine and severed.

The tumor is lined by what should have been the upper anterior and lateral parietal peritoneum. This peritoneum with the bowels and mesentery is shelled from within the sac with difficulty, entirely around to the edges of the ring within the abdomen. The bowel is slowly returned within the ring. The tissue being so thin, no effort is made to close the anterior peritoneal opening separately.

Chromic catgut mattress-sutures are placed through the fascia and muscles, closing the ring completely with a reinforced continuous suture of this same material. The skin is closed with plain catgut.

Postoperative History.—The patient made an uninterrupted recovery, which was unexpected, and was a perfectly healthy baby six months after the operation.

CLINIC OF DR. LEO ELOESSER

SAN FRANCISCO HOSPITAL

INTRAPLEURAL PNEUMOLYSIS

OPERATIONS that open the pleural cavity have been taboo in the surgical treatment of pulmonary tuberculosis; all of the various procedures made popular within the last decade have been designed to collapse the lung from without the pleura. Sauerbruch's extrapleural thoracoplasty; avulsion of the phrenic nerve, and various combinations and modifications of these two types of operation seek to compress the thoracic wall and thus indirectly the lung itself.

However, none of the more extensive surgical operations can vie in completeness with the simple procedure upon which all of them are based, viz., artificial pneumothorax. This original intrapleural compression still remains the ideal whenever it can be attained, wherefore various intrapleural maneuvers have been proposed to complete it when adhesions to the chest wall hold the lung partially distended.

Jacobaeus introduces a cauterizing thoracoscope into the chest through a small incision, and with it burns apart adhesive strands. This maneuver, however, is not likely to find wide application.

The thoracoscope is a difficult instrument to manage, like all endoscopes that look in upon a wide space through a very small keyhole. It takes much practice and great skill to handle it at all; it is not without danger even in the most skilful hands. Thus there have been, and will be, but few to use it. Alexander, in his recent book (a mine of information, by the way, for those interested in pulmonary tuberculosis), says that Jacobaeus has done 120 thoracoscopies, and that twelve or fifteen surgeons all told have done 200 more. The danger of the method lies in

postoperative empyema, of which Jacobaeus himself has 10 per cent. The empyema arises from severed adhesions which contain lung tissue pulled out into a long teat; tubercular material may exude from their cut surface into the chest. A gross perforation, a spontaneous pyopneumothorax, may occur; the patient may cough and blow the contents of a tubercular abscess into his chest if the adhesion is severed too close to the lung. But aside from its dangers, Jacobaeus' procedure is insufficient. There are few pneumothoraces in which merely one or two or three long thin cords hold the lung distended. More often the adhesions take the form of sheets or bands, especially where they form along the interlobar septa after an interlobar pleurisy. And obviously these sheets and bands cannot be burnt asunder through the small opening of an endoscope. Brauer recognized these difficulties when he proposed his original method of inducing artificial pneumothorax through an intercostal incision instead of by a subcutaneous puncture.

A few surgeons have tried to sever pleural adhesions manually and under guidance of the eye through a wide opening into the chest. Alexander cites Torek (1914), Ulrici (1918), Eden (1918), Riviere and Romanis (1923).

The first three communications date back seven years, a long time in this rapidly moving current of pulmonary surgery. I do not know whether the authors are still doing their intrapleural operations or not; probably not, as no further communications on the subject have come from their pen. Each reports 1 case; all ended fatally, 2 had perforations and empyemas, 1 a contralateral involvement. Schottmüller (1918), however, reports a successful case; A. Mayer (1913) another, doubtful perhaps, reported as fully able to work eight weeks after operation.

Riviere and Romanis (1923) divided seven thick adhesions with scissors and cautery; a sinus developed, the outcome was bad. They concluded that extrapleural operations are to be preferred as far as possible to intrapleural division of adhesions.

Sauerbruch has performed the operation five times; once with full success; a second patient got an empyema, but re-

covered; three others died, one two days, one three weeks after operation, one several months later following an extrapleural thoracoplasty done to close an empyema cavity. He condemns the operation.

Brunner, in his latest work on the methods practised in Sauerbruch's clinic, does not mention the method at all. Sauerbruch has evidently abandoned it.

Alexander cites a number of additional cases, and from the facts which he presents draws the conclusion "that thoracoplasty is preferable to pneumothorax which must be preceded by so risky an operation as open intrapleural pneumolysis"—a very just conclusion for most cases, and certainly for those in which a general anesthetic comes into question.

If a general anesthetic is necessary then one must agree with Alexander that intrapleural operations are out of place; there can be no question that it harms a tubercular lung to flap violently about in a wide open pneumothorax. The danger of such an insult would outweigh the risk of an extrapleural thoracoplasty. If, however, one can open the chest and have the patient breathe quietly the while, and can quickly and gently and securely sever a few adhesions between ligatures, then attempts at intrapleural loosening of the lung may occasionally be justifiable.

I shall ask you to let me discuss the records of four patients who have been subjected to this operation. I am not going to plead for or against it. Indeed, you can gage my doubts of its propriety by the fact that the most recent operation dates back almost three years. The last two results seemed disappointing, but long observation has restored my hopes.

The operations and their sequels are interesting; even more so the method of anesthesia. Its scope has been much widened in the last two years. Local anesthesia after preliminary artificial pneumothorax has proved useful in thoracotomy done for other indications besides pulmonary tuberculosis; in cancer of the esophagus and other diseases. The method has considerable possibilities; it will be discussed more fully in a later communication, but it is so interesting theoretically as well as useful prac-

tically, that I cannot forego the temptation of touching upon it here.

Dr. Evarts Graham's researches on open and closed pneumothorax by which he arrives at certain limits for the area of an opening into the chest compatible with continuance of sufficient respiration, would make it seem impossible that a trap-door with an area of 10 or more square inches might be cut into the chest without causing suffocation. Dr. Graham, reckoning an average vital capacity of 3700 c.c. and a surface area of the glottis of 2.25 cm., and assuming a mobile mediastinum, places the limit of the opening into the chest for which compensation can theoretically be established even for short periods at 51.5 sq. cm., or about 2 by 4 inches. However, if we make an artificial closed pneumothorax slowly, by easy stages, and accustom the patient to the deficit in his normal vital capacity for several days, then we may open the chest widely with an indefinitely large opening, it seems, without disturbing the subnormal respiratory equilibrium to which he has become accustomed. You will offer the explanation that in producing artificial pneumothorax we have likewise caused more or less pleurisy and have thickened and stiffened the mediastinum, and that it is this that allows the patient to breathe with his one lung no matter how widely his other chest may be open. True, this objection may play a rôle, but whatever slight stiffness of the mediastinum the preliminary pneumothorax may have produced will by no means entirely account for the extraordinary spectacle of a man awake and breathing quietly with an opening in his chest through which one may easily introduce both fists. Immobility of the mediastinum is not the only factor, for the patient breathes quietly only as long as he makes no respiratory effort whatever against the closed glottis. Let him cough, or cry out, or strain and the respiratory balance is immediately upset: the mediastinum begins to flap about; the collapsed lung begins to balloon out; the man becomes breathless, gasps, and shows all the distress of a sudden open pneumothorax. But if the opening into the chest is held shut and the patient is quieted; if he is made to stop coughing or crying out or straining, and made to breathe quietly again, the

chest may be reopened and respiration will proceed as undisturbedly as before. There is some other factor, then, in the gradual induction of a preliminary pneumothorax besides stiffening of the mediastinum, if stiffened at all it be, which maintains quiet respiration in the face of an impossibly wide opening. I shall vouch no explanation of this phenomenon, but whatever the mechanism, it is a delicate one, an unstable balance, easily upset, like balancing a feather on the tip of one's nose.

This, then, is the method of opening the chest without disturbing respiratory balance, without disturbing the collapsed lung, which lies perfectly quiet at the bottom of the chest, that made an attempt at open pneumolysis seem justifiable.

The technic of operation is simple. The line of incision is infiltrated with $\frac{3}{4}$ per cent. novocain-adrenalin solution; another subcutaneous injection along the clavicle blocks the suprasternal and supraclavicular branches to the skin of the chest; the intercostal nerves are usually injected later, after the superficial soft parts have been incised. A trap-door incision with its base outward severing the first, second, and third costal cartilages gives access to the chest, in the bottom of which the partially collapsed lung appears, held distended by various strands, sheets, and bands of adhesions. The longer strands are tied between two ligatures and severed with the galvanocautery; thin bands are also severed and tied; the adhesions bleed readily and need ligatures. Broad flat adhesions are separated from the chest wall by making a subpleural injection of novocain, incising the parietal pleura around the adhesion, and separating the pleura from the endothoracic fascia. It is not wise to try to part dense broad adhesions from the pleura by blunt violence; the lung will tear. You will remember from the autopsy room how tightly the apex often clings to the chest wall and how hard it is to tear it away with the hand. These dense adhesions between the apex and the parietal pleura should not be disturbed, but the parietal pleura should be incised and separated from the endothoracic fascia in a plane where cleavage is much easier. Thus at this point the operation works in an extrapleural plane—an intrapleural approach, but a partly extrapleural lysis, if you will.

After the adhesions have been severed the soft parts are closed with catgut, and the skin with silkworm and metal clips or horsehair.

The records of four patients subjected to intrapleural pneumolysis follow:

Case I.—Mrs. A. M., age fifty-one. Referred by Dr. Mary Mentzer May 27, 1922. Cough since 1917. Tubercle bacilli found January, 1918. Mainly left-sided pulmonary tuberculosis

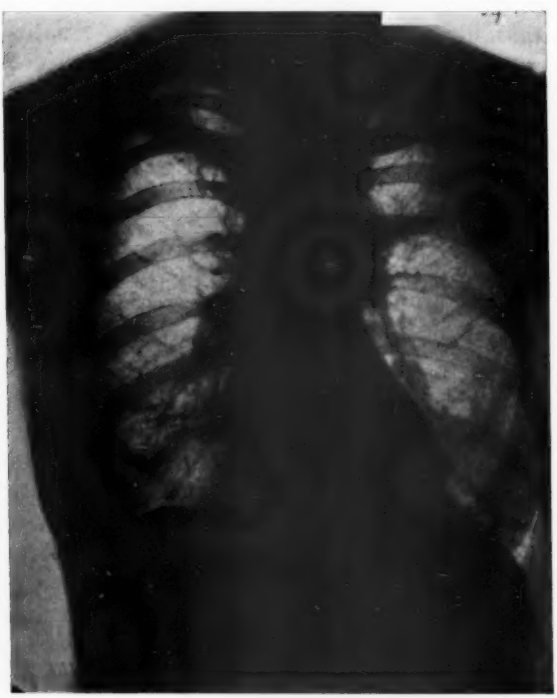

Fig. 140.—Case I. Large cavity, middle of upper left lobe.

with central apical cavity which repeated pneumothoraces fail to compress; the upper lobe being held distended by apical adhesions. An unlimited amount of air may be introduced without

raising the pressure; however, the bronchopleural communication which perforce must exist is not demonstrable.

Operation (June 7 1922).—Under satisfactory local anesthesia, curved incision running down to left of sternum, from first to third intercostal spaces, then along third intercostal space

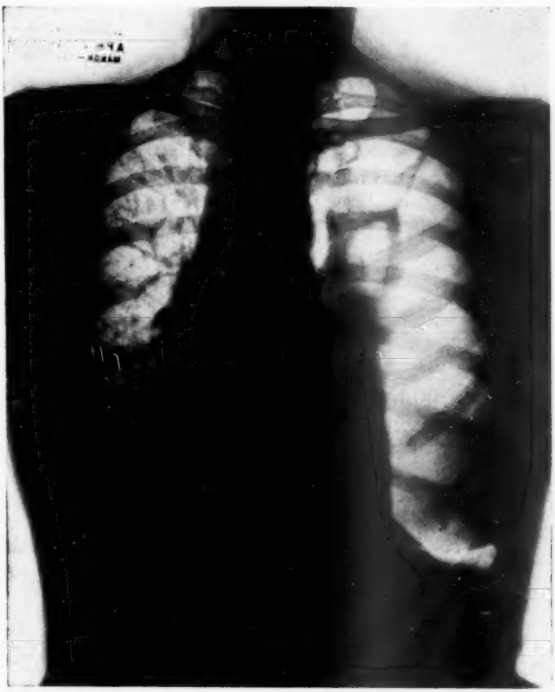

Fig. 141.—Case I. Pneumothorax; the cavity held distended by bands of adhesions.

to left, as far as anterior axillary line. Second and third ribs are severed at the costocartilaginous junction, and the intercostal spaces opened and flap turned back. The lung lies collapsed at the base of a large pneumothorax, and the patient experiences no more difficulty in breathing with her chest open than she did with it closed. The lung does not inflate during

breathing. Exactly as apparent in the *x*-ray, there are found two adhesions from the top of the lung to the top of the thorax, one-half the caliber of a lead pencil, and dense. There is a third broad adhesion, 1½ inches wide, between the posterior surface of the lung and the rear of the chest, at about the level of the fourth or fifth rib. This broad adhesive band is likely the site at which the thickened interlobar septum has become adherent to the parietal pleura. It is impossible to separate this septum by tearing with the hand, and, as it cannot be reached by the scissors, it is separated by removing the parietal pleura from the chest wall at this place. There is a fourth thick adhesion just lateral to the broad one mentioned above. The lung is palpated without pain to the patient, but there is no cavity, as such, palpable under the fingers, although the upper part of the lung, corresponding to the space visible in the *x*-ray, contains an induration which may perhaps represent a cavity wall.

Chest is closed with a small drain led down through the muscles, but not into the chest, in order to prevent subsequent subcutaneous emphysema. The patient stood operation well and retained a good pulse throughout.

She felt considerable pleural pain when the adhesions were pulled upon. The rest of the operation was painless. Uneventful recovery from operation.

The patient continues to receive insufflations of air at monthly intervals. Large amounts (2000 to 3000 c.c.) of air still fail to raise the pressure. She has gained 44 pounds, has no fever, does her housework, and is well except for a slight cough and a daily expectoration of 10 c.c. which still contains tubercle bacilli.

Case II.—Miss F. B., aged thirty-seven. Referred by Dr. P. K. Brown. Sick since September, 1922. Ten pneumothoraces from October 1, 1922 to April 11, 1923. Mainly left-sided tuberculosis.

Operation (April 20, 1923).—Under sufficient, but not quite satisfactory, local anesthesia curved incision following first intercostal space left, crossing the second, third, fourth ribs, and following the fourth intercostal space. The first, second, third, and

fourth ribs are incised about ½ inch to left of the sternum. The chest is small and access is poor until the ribs are bent back at their costochondral junctions, which is done very easily, as the ribs are atrophic. The lung is adherent over its upper lobe by broad and firm folds of adhesions, which are quite hyperemic

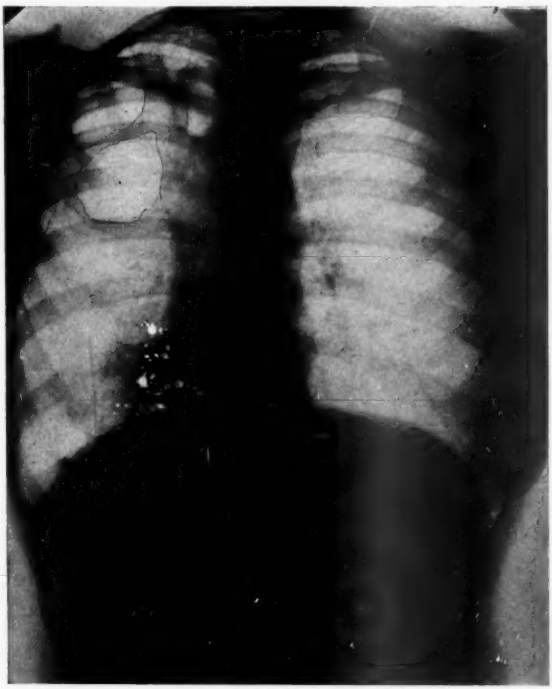

Fig. 142.—Case II. A large cavity of the left upper lobe is uncollapsed in an artificial pneumothorax; being held distended by adhesions.

and carry small tortuous arteries. The appearance of the *x*-ray is deceptive: there are no long-drawn-out strands; what appear to be strands in the *x*-ray are pleural folds. With a thermo-cautery (after a subpleural injection of novocain which made painless stripping the pleura and severing it) the parietal pleura is separated over an area about equal to the palm of the hand,

and running from the level of the third rib to the very dome of the pleura. This allows the lung to drop back over its distended area. There is felt in the lung an induration which probably represents a cavity. There is some bleeding from the raw area,

Fig. 143.—Case II. The upper part of the lung is fully collapsed ten days after open pneumolysis; the base is still held by diaphragmatic adhesions. There is a tube in the chest.

but this is stopped by touching the bleeding points with a Paquelin cautery. It is not possible to cover the raw area of either the lung or of the parietal pleura. The chest is closed, leaving a catheter in place. Before closure the patient is asked to make deep inspiration.

The pressure after operation, measured through the catheter which had been clamped before measurements, shows about plus and minus 2, perhaps ½ cm. of positive pressure. Four

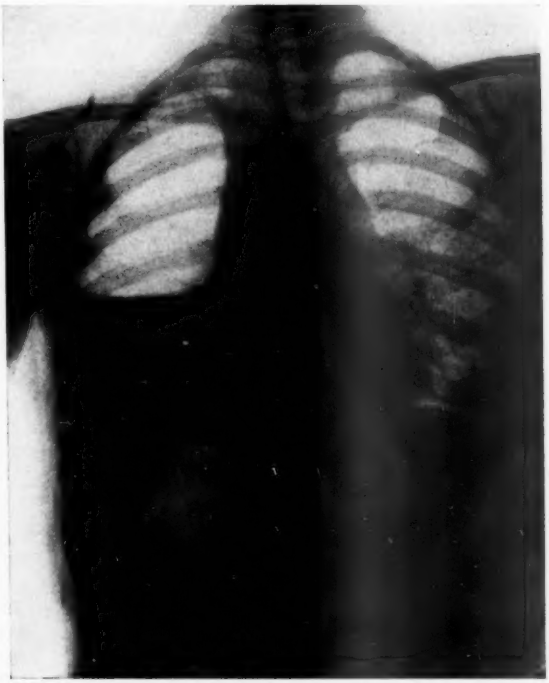

Fig. 144.—Case II. The lung is fully collapsed and the cavity has disappeared twenty days after operation, but there is fluid in the chest.

hundred c.c. more of air were put into the pleura, the pressure being as follows:

0 c.c.	minus 2	plus 3
200 c.c.	minus 4	plus 4
300 c.c.	minus 4½	plus 4
350 c.c.	plus 2	plus 5
400 c.c.	plus 1	plus 5

Dr. Botsford was called upon to administer an anesthetic should gas be necessary, but her services were not needed.

April 24, 1923: More air injected.

April 25, 1923: Pressure plus 1 to 0; no further air is introduced, the patient being dyspneic. Roentgen examination shows the left lung completely collapsed, the mediastinum much displaced to the right. The drain was removed on April 27, 1923;

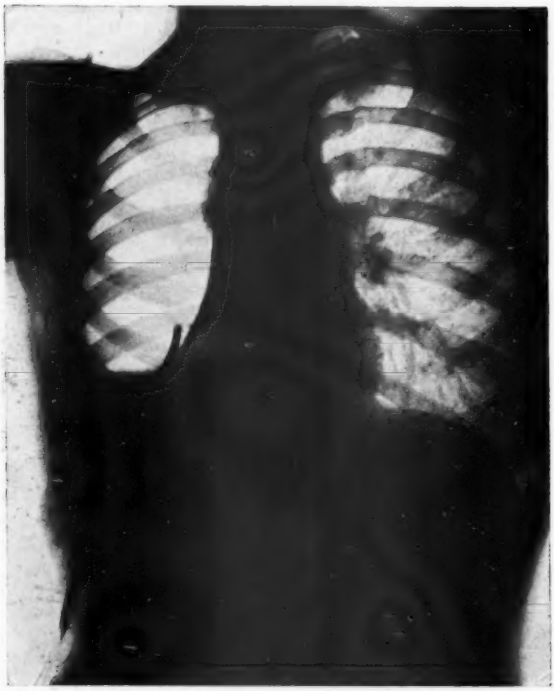

Fig. 145.—Case II. The collapse remains complete forty days after operation; the fluid has been drained through the tube.

the next day a little air and fluid began to leak through the site of the drainage-tube. On April 29th the temperature rose to 102° F. and an empyema appeared containing staphylococci and streptococci. This was drained through an intercostal incision May 1, 1923. The patient tasted the Dakin's solution with which the chest was irrigated, and on May 23d coughed up mer-

curochrome, thus establishing the presence of a communicating pyopneumothorax. From now on she had a hard struggle with her empyema. On June 8th she coughed up a bit of black tissue, probably lung. On June 9th the empyema was drained by resecting a rib. A sinus formed in the anterior scar near the ster-

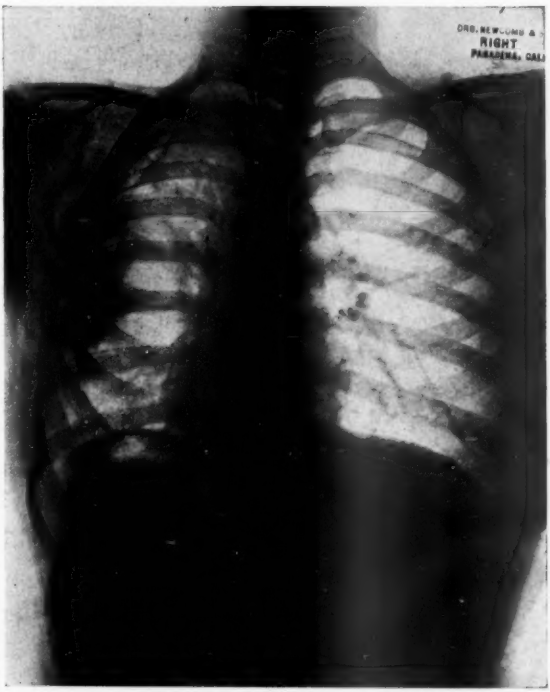

Fig. 146.—Case II. The lung has re-expanded, but the cavity has disappeared; there is a small pneumothorax in the upper part of the chest with an encapsulated empyema below. (Nine months after operation.)

num, communicating with the lung and discharging air and pus. By January, 1924 she had begun to gain weight; the discharge continued, however, and she suffered from recurrent attacks of fever which rose when the drainage from the posterior sinuses was insufficient. On August 14th a portion of the lateral chest

wall about the size of an open hand, including five or six ribs and their intercostal tissue, was resected and allowed to drop into the large empyema cavity. The cavity lay anterolaterally; its wall was very thick. After this operation the patient steadily improved. On July 14, 1925 she removed the drainage-tube

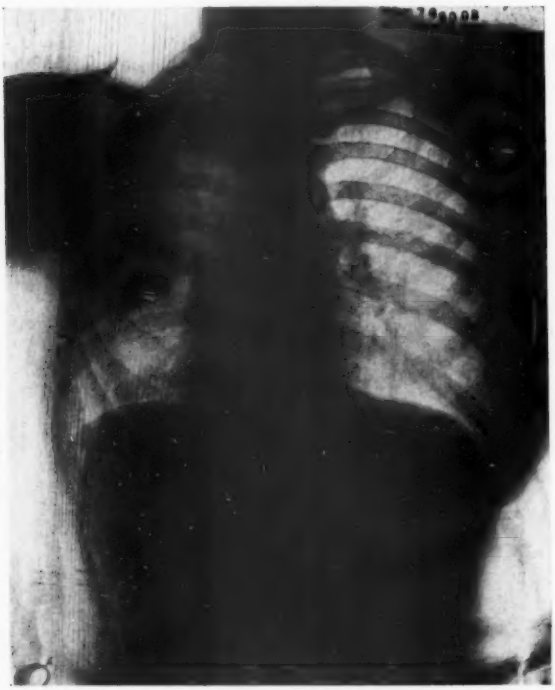

Fig. 147.—Case II. The pneumothorax has disappeared; the empyema has grown larger. (Fifteen months after operation.)

from the site of the rib resection. The anterior sinus opened and closed at intervals, but no longer communicated with the lung. No further air came from it.

By the fall of 1925 all the sinuses had closed; expectoration and cough had ceased; the temperature was normal; she no

Fig. 148.—Case II. Several thoracoplasties have succeeded in collapsing the chest and curing the empyema. The partially collapsed left chest is clear. The patient is well and working. (Two years and three months after pneumolysis.)

longer felt tired and was doing much against my wishes, strenuous twenty-four-hour duty as a nurse in a small hospital.

Case III.—Miss A. I., aged twenty-four. Referred by Dr. P. K. Brown. Influenza 1918; not well since. Dyspnea 1919. Arequipa Sanitarium June, 1922. Two moderate sized cavities and multiple small ones right. Fifteen pneumothoraces, 200 to 1200 c.c. Sputum 175 to 150 c.c. contains tubercle bacilli. Temperature 100.5° to 97° F., pulse 80 to 100. Mainly right-sided tuberculosis; left side free, except for some râles at the top.

Nervous girl. Repeated pneumothoraces on account of multiple cavities at the hilus. Each pneumothorax was at first followed by fever, and she has also had occasional rises of temperature in the intervals.

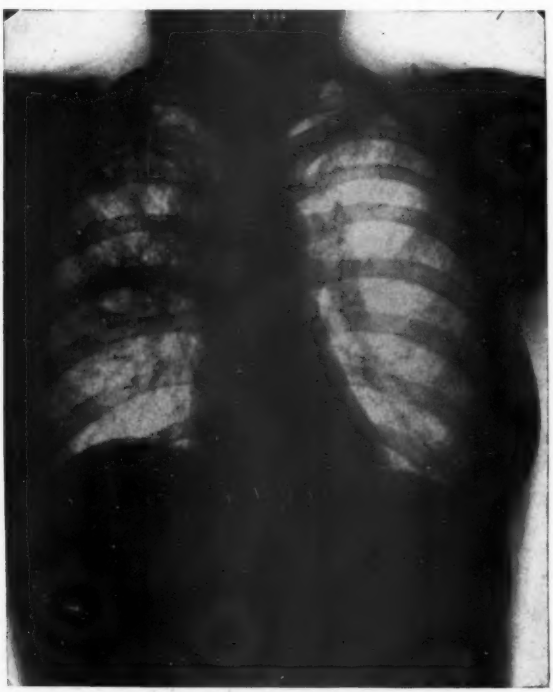

Fig. 149.—Case III. Multiple cavities at the right hilus; the lowest has a fluid level.

x-Ray shows what appear to be multiple adhesions over the apex, possibly an apex adherent to the dome of the pleura as a whole. Furthermore, there are strands and also a fairly broad sheet of adhesions at the middle of the lung. At the base there are adhesions to the diaphragm and a small collection of fluid above.

After much discussion with Dr. Brown, I consent, although reluctantly, to operate. I am very doubtful whether severing the adhesions will contribute to further collapse. The radiographic appearance of the lung seems to me to indicate a fairly massive hilus consolidation with peribronchial lymphangitis and

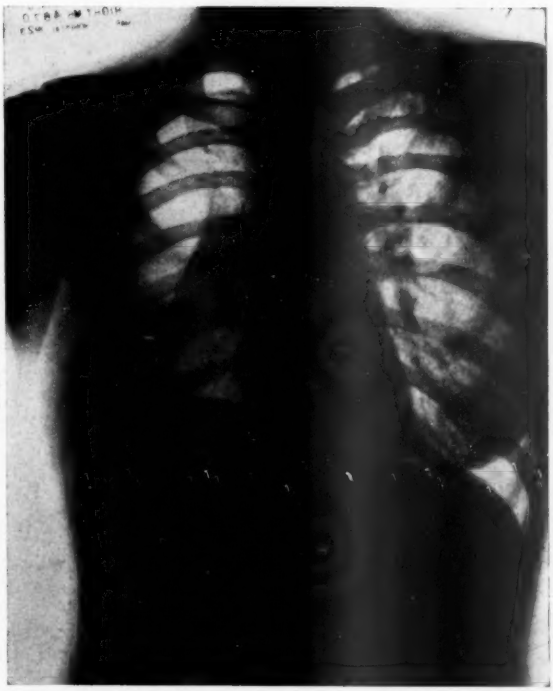

Fig. 150.—Case III. One month after pneumolysis. The upper part of the lung is well collapsed; the cavities are no longer to be seen; the base is still distended by diaphragmatic adhesions.

cavitation between, which, although the adhesions be severed, would probably not admit of complete collapse. I agree, however, that her apex is probably held extended by the adhesions, and also her base.

Operation (February 3, 1923).—Under satisfactory local anesthesia a curved incision is made in the front of the chest under the

clavicle, following the crest of the first rib, then downward across the first and second ribs. The pectoral is displaced laterally, the first and second ribs cut across, and an incision parallel to the first rib made above it; this trap-door is pulled open. In spite of the wide pneumothorax the patient experiences not the

Fig. 151.—Case III. Two months after operation. The upper lung is perfectly collapsed. The cavities are no longer to be seen. The base is still distended.

least respiratory shock and the respiration is not accelerated. Multiple thin strands of adhesions come to view as follows: A strand 3 to 4 mm. in diameter running from the upper part of the chest anteriorly down to the middle of the lung; multiple thin strands and thin sheets of adhesions extending from the dome of

the pleura to the very apex; and several thin strands at the base of the pleura. These strands are severed with the galvanocautery; some bleed and are tied off. There is no adhesion to the diaphragm, but there was evidently a recent attachment, as the

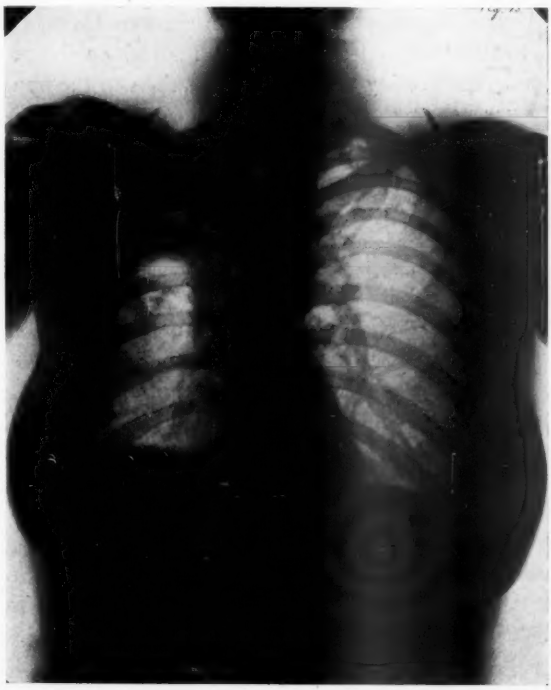

Fig. 152.—Case III. One year and eleven months after operation. The lung has re-expanded except at the right top where there are irregular shadows, probably multilocular pneumothorax. The hilus cavities seen in Fig. 149 are gone. The trachea and the heart are pulled strongly to the right and the right side of the thorax is also shrunken. This film looks as though the patient were a fit candidate for thoracoplasty.

edge of the lower lobe is covered by a recent deposit of fibrin. The main adhesions lie at the base of the upper lobe posteriorly. These are so firm that it is impossible to tear them with the hand and they cannot be reached with the galvanocautery. Severing

the other adhesions permits the lung to be pulled forward, after which these posterior adhesions are accessible, though with difficulty. To prevent bleeding they are caught with catgut passed through a needle, and are then severed with the scissors. The final severance is quickly made with the hand, which strips the lung from the parietal pleura, a part of the parietal pleura coming away with it, so that a raw surface remains on the posterior chest wall. In severing some of the adhesions to the upper lobe the lung parenchyma came to view; it was studded with small sago-like granules, evidently minute tubercles. There was no miliary dissemination in the pleura itself. This last forcible tearing away of the lung from the pleura was painful, but lasted only a moment. Blood-clots amounting to perhaps half a teacupful were removed from the chest and, hemorrhage having stopped, the wound was closed without drainage. The patient was returned to bed without respiratory difficulty. A sand-bag was put over her wound to prevent subcutaneous emphysema.

February 6, 1923: Artificial pneumothorax.

February 12, 1923: Sutures out, wound healed.

February 14, 1923: Eight to 12 ounces of serosanguineous fluid from opening in incision size of pinhead. Subcutaneous emphysema.

February 16, 1923: Fluid; possible streptococci (?).

March 12, 1923: Sputum 40 c.c

May 9, 1923: Sputum 20 c.c. Gained 12 pounds since operation. Temperature 98.4° to 99.5° F. Pulse 80 to 140.

November, 1925: She is now up and about, but still under treatment at the Arroyo Sanitarium.

Case IV.—Gertrude D., aged fourteen. Referred by Dr. P. K. Brown. Right-sided tuberculosis with large cavity at the hilus and fluid level. Pneumothorax produces only partial compression. The apex shows no adhesions. In the *x*-ray appear both diaphragmatic adhesions and adhesions around the top of the middle lobe which seemingly hold the cavity distended.

Operation (February 3, 1923).—Under satisfactory local anesthesia an incision is made parallel to the clavicle, then downward

across the first, second, and third ribs, then curving laterally for about an inch. The first, second, and third costal cartilages are severed and the pleura opened. This occasions no respiratory difficulty until the patient begins to cough or to make respiratory effort, whereupon the respiration immediately becomes much

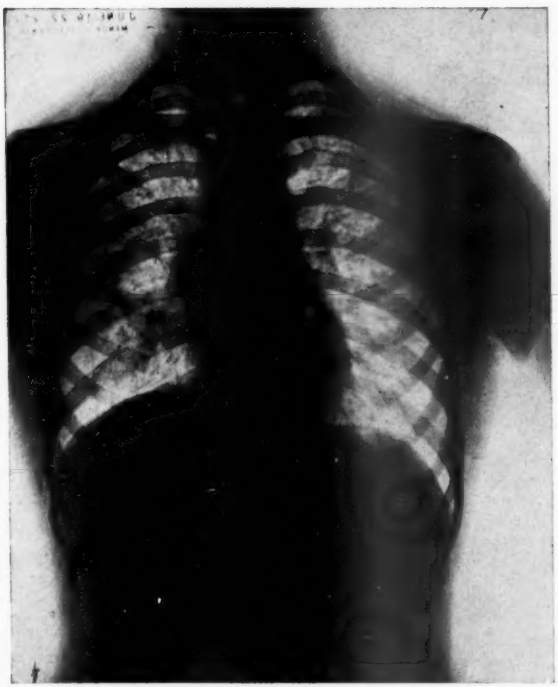

Fig. 153.—Case IV. Bilateral involvement, mainly right sided. There is a large right central cavity with a fluid level.

embarrassed so that the large trap-door is closed with damp towels until the girl becomes quiet. The operation then proceeds. Several strands of adhesions 3 to 4 mm. across, running from the anterior chest wall to the front of the lung, were burnt through with the galvanocautery. There were adhesions between the diaphragm and the base of the lower lobe which were easily severed

with the galvanocautery, a raw area on the top of the diaphragm resulting. The lung was soft and, although extensive palpation was not done, no indurated areas could be felt in it. The main mass of adhesions lay in back of the middle lobe, probably cor-

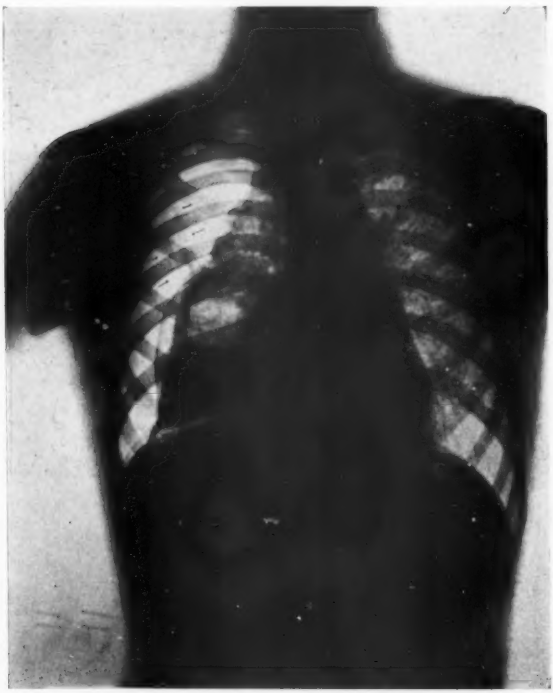

Fig. 154.—Case IV. After pneumothorax the apex is well collapsed, but the base is not. The arrows point to long-drawn-out adhesions in the region of the interlobar septum which apparently keep the large cavity from collapsing. There are diaphragmatic attachments at the base.

responding to the interlobar septum between upper and middle lobes. These were attached to the back of the chest in numerous broad bands, covering an area perhaps the size of a dollar. They were not apparent in the radiographs. As it was impossible to reach them with the galvanocautery from the front, they were

Fig. 155.—Case IV. One month after pneumolysis. The apex has re-expanded, but the base is well collapsed and the large cavity is no longer visible.

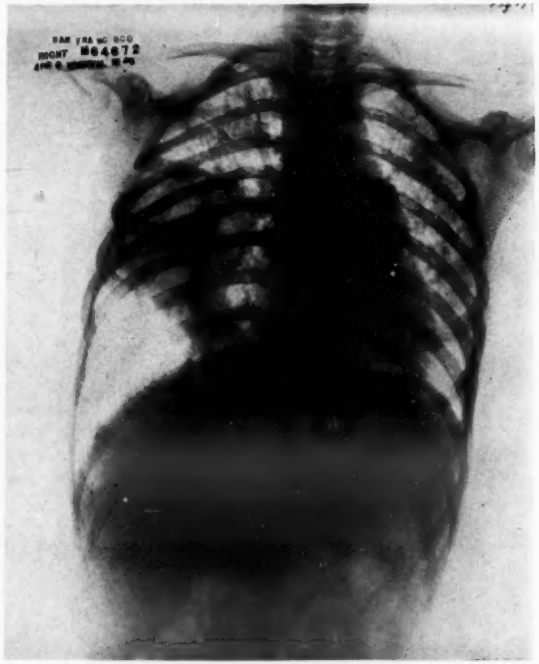

Fig. 156.—Case IV. Two months after pneumolysis. The pleura at the upper part of the basal pneumothorax is gray and thickened; the base is beginning to re-expand.

partly severed with curved scissors and finally torn loose with the hand, a raw area remaining at this point and some of the parietal pleura coming away in the course of separation. This tearing away of the lung was very painful. The chest was then closed. A thin rubber catheter was inserted until the later clos-

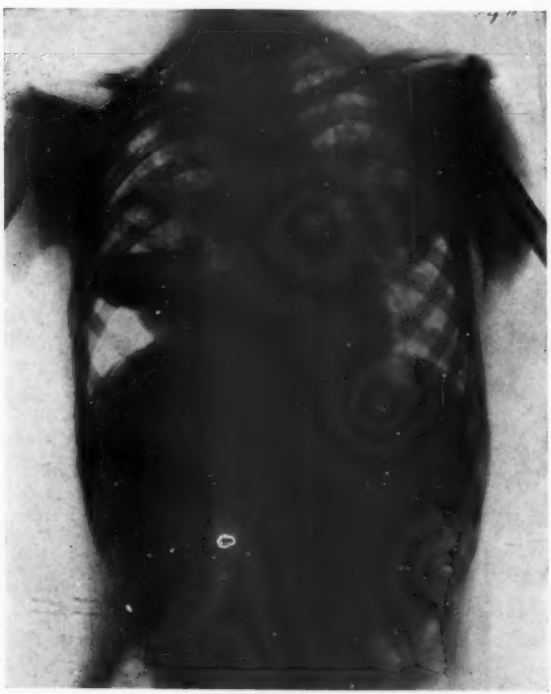

Fig. 157.—Case IV. Two and one-half months after operation. There are two collections of fluid, each with a separate level in the meshes of the thickened pleura at the base of the chest.

ure of the wound. The catheter was attached to a pneumothorax apparatus and air insufflated.

The readings were as follows:

Air.	Pressure.	Oscillations.
0 c.c.	plus 1	5
250 c.c.	plus 2	5
500 c.c.	plus 2	5

The catheter was removed from the chest. The child was put to bed without respiratory embarrassment.

It was striking in this case (and in that of Miss A. I.) to see how well the wide opening of the chest was tolerated and how, in spite of the wide pneumothorax, breathing was perfectly

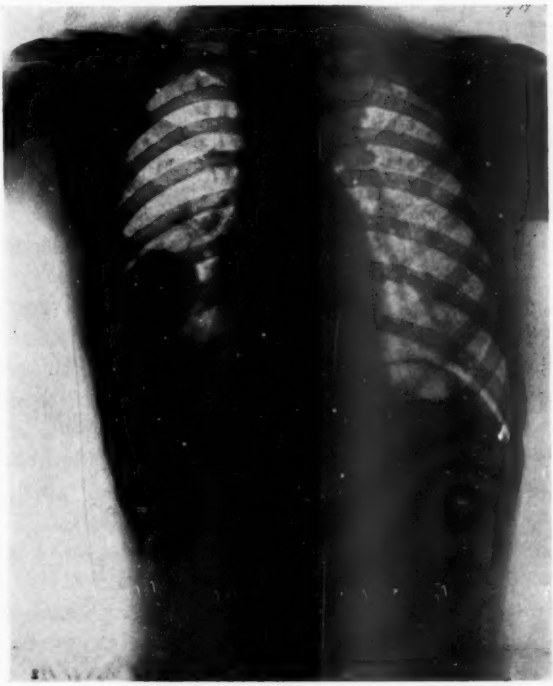

Fig. 158.—Case IV. Two and one-half years after pneumolysis. The lung has re-expanded, but the cavity is gone. In the bottom of the chest is a round shadow which probably represents an encapsulated collection of fluid. This shadow has remained unchanged for many months.

quiet as long as the patient made no effort at phonation, or breathing against the closed glottis.

A sinus formed in the incision, discharging pus for a time. This has been closed for over a year. The patient is at home, has gained her normal weight; cough, fever, and expectoration

have ceased. She is steadily improving and bids fair to recover.

So that of these 4 patients one may be considered as cured; 3 are greatly improved; of these, 1 is doing her full day's work as a housewife, but still has a little expectoration; 1 is up and about her home; the third is still under sanitarium treatment.

EXARTICULATION AT THE KNEE-JOINT

BEING now in a dissenting and contentious mood, let us broach another procedure, which in theory having no little authority to back it, may not be heretical, but which in practice seems to be so, so rarely does one see it done.

The War brought forth some advances in the science and art of ablating limbs. Not many, for most limbs were removed on account of infection, actual or feared, and our ancesters of one hundred years ago knew about as much as we do of the science of amputation, besides being vastly defter masters of the art. Barring, then a few osteoplastic and muscle and tendon plastic procedures, depending for their success on asepsis, most of them more or less artificial and tickling rather the vanities of an operator enchanted with the exercise of manual virtuosity than pleasing the patient by the usefulness of their outcome, all thinkable practical and impractical varieties and twists of amputation were known fifty or more years ago. So, naturally, was exarticulation at the knee-joint, which seems first to have been proposed by Guillemeau in 1612. Stein and Brasdor (1758) recommended it. The swing of preponderance in the struggle between amputation versus exarticulation, the various viewpoints determining the preponderance, and the various modifications that were designed to make a compromise between the disadvantages of each of these operations make an interesting chapter of medical history, a pitiable one at times.

Exarticulations were late to gain a place in surgery. They had been favored in the hope of avoiding pyemia from osteomyelitis of the severed bone by leaving the bone-marrow unopened. This advantage, however, had been offset by the larger, uneven wound, full of hidden pockets and recesses which was made when the joint was opened, as well as by the longer flaps necessary to cover the broad condylar surfaces, which, by their length, were predisposed to gangrene. Surgeons had hoped to have better

end-bearing from the broad joint surfaces than ever they could from the sharper amputated bone ends. Their hopes were frustrated whenever the exarticulation stumps failed to heal by first intention. If they festered then the broad condyles shed their cartilage after an interminable time of suppuration; they were finally covered by a large ulcer or a wide thin scar. Seeking to combine the advantages of a large weight-bearing surface with those of a raw bony one to which the soft parts would sooner adhere than to cartilage, Syme and, later, Carden introduced their supracondylar amputations. The functional results of their operations were so good and their mortality so low that they soon displaced exarticulations altogether.

Schede, writing at the beginning of the antiseptic era (1882) for Pitha-Billroth's Handbook of Surgery, says that amputation and exarticulation are entirely equal in value.

Of modern American texts, Bickham prefers exarticulations at the knee to supracondylar amputations; Horsley recommends a thigh amputation 3 inches above the knee or 2 inches above the condyles. English texts—Rowlands and Turner (Jacobson)—prefer an exarticulation to a Gritti or a Stokes amputation; so does Treves (Hutchinson); Wheeler expresses no preference, but says that exarticulation gives an excellent stump.

Here in San Francisco exarticulations at the knee are done but rarely—too rarely. The operation is an American one, Stephen Smith first described it. One may use Smith's lateral flaps or a long anterior one. The patella is left untouched. It is well to sew the patellar tendon with a few strong mattress-sutures of kangaroo-tendon or gut to the gastrocnemius tendons or the remnants of the hamstrings. This suture relieves the anterior flap of tension, which is particularly noxious to it in operations for gangrene or other vascular disease.

Arteriosclerotic gangrene with or without diabetes, Buerger's disease, and arterial embolism form the most frequent indications. Exarticulation is to be preferred in the aged and decrepit to a thigh amputation. It can be more rapidly and easily done. No blood need be lost; the shock is less, the stump is good, and if the patellar tendon is sewn to the hamstrings, as described

above, the skin flaps seem to be so relieved of tension that they show no tendency to slough, even though the long anterior flap be used, which falls naturally into its place over the condyles when the patient is on his back. One frequently sees an exudate form in the suprapatellar pouch, but the joint should by no means be opened on this account. The fluid should be aspirated, repeatedly if necessary; in some cases we have even punctured the pouch and drained the fluid through a glass drain for a day, after which the stumps have healed. Occasionally a little fluid drains through the incision; the drainage stops spontaneously; we have had no suppuration on this account. Some of the earlier exarticulations were treated by the open method with Dakin's solution. After the cartilage had sloughed, leaving the ends of the femoral condyles cleanly granulating, a Carden supracondylar amputation was done and the wound closed. My statistics for the last five years are as follows:

There were 22 exarticulations; the patients' ages ranged from twenty-five to seventy-five years; 16 exarticulations were performed for gangrene, of these, 6 were diabetic, 3 arteriosclerotic without diabetes, 4 endarteritic, and 3 embolic, the emboli originating in a fibrillating myocarditic heart. Two exarticulations were done for tuberculosis of the knee-joint and 4 for various suppurations, traumatic and infectious (gas gangrene, ulcers, and osteomyelitis of the leg). Fourteen patients were cured, 8 died: 3 diabetics of coma, of sepsis from a large decubitus, and 1 of unknown cause; 1 endarteritic of an ascending thrombophlebitis; 1 arteriosclerotic, probably result of pneumonia, 1 patient with embolism died of heart-block, 1 with tuberculosis of tubercular empyema, 1 with gas gangrene of ascending infection. Three of the exarticulations were left open: of these, 2 died; in the other the protruding femoral condyles were amputated according to Carden and the wound closed. All of the remaining stumps healed without requiring further amputation; many of them had a discharge of synovial fluid and some of pus from an open sinus, but all of the sinuses closed without further intervention; some of them had small ulcers remaining after necrosis of the wound edges, but these also closed.

Two senile diabetics had healed stumps when they died two or more weeks after operation. The gangrene involved the foot seven times, the leg nine times. Seven patients had had their toes or part of the foot amputated in an unsuccessful attempt to combat the gangrene by local operations; all of these had ascending infections of the foot and leg. Three had had a sympathectomy (stripping of the femoral artery) with no benefit.

From the total mortality of 8/22, or 36 per cent., we may legitimately deduct 2 patients who died of causes apart from operation (diabetes, pulmonary tuberculosis) two or more weeks later. This leaves a mortality of 6/22, or 27 per cent., among patients whom the operation failed to cure; there were no deaths from the operation as such, from shock or loss of blood.

Let us compare with these statistics others:

There were 14 thigh amputations done at the hospital during the same period; 11 were for gangrene, one of these was due to embolism, 2 to endarteritis, 5 to arteriosclerosis without diabetes, 3 gangrenes occurred in diabetics; 3 thighs were amputated for sepsis. Eight of the 14 patients died: 3 of shock, 2 in diabetic coma, 1 probably of sepsis, 2 senile individuals of unknown causes. Of the 6 survivors, 3 were discharged with open stumps.

Thus we have a total mortality of 8/14, or 57 per cent., all in the first two weeks after operation, as against a total mortality of 36 per cent. (and 27 per cent. in the first two weeks) for exarticulation; and an immediate operative mortality from shock or hemorrhage of 21 per cent. as against 0 per cent.

You may object that the patients subjected to thigh amputation were sicker, that their gangrene was more destructive, and that this will explain the greater mortality. This is not so; the gangrene involved the leg three times and the foot eight times; the balance therefore lies more unfavorably for the exarticulations, in which the foot was gangrenous 7 times, the leg 9 times.

Of leg amputations there were 22, 19 for gangrene; of these, 6 were arteriosclerotic, 5 diabetic, 7 endarteritic, 1 embolic. Three amputations were done for infections of various kinds. Five patients died: 1 of embolism, 2 of pneumonia, 1 of gas gangrene, 1 of unknown cause.

The mortality is lower than that of exarticulation at the knee: 5/22, or 22½ per cent., as against 36 per cent. The objection, however, will hold that the gangrene was much less extensive and involved only the toes or the forefoot.

The stumps were not nearly so good: 14, more than half of them, were unhealed; 11, or half of them, required reamputation; most of them were tender and unsatisfactory. Whatever added risk there may be in exarticulation at the knee is more than offset by the better stump.

Therefore, for gangrene of the foot or leg exarticulate at the knee rather than do a thigh amputation. If the gangrene does not extend beyond the toes, a leg amputation is permissible; it sometimes gives a moderately useful stump, especially in younger endarteritic patients, rarely an entirely satisfactory one. In the aged it is scarcely worth while; the knee stump is far better than the tender and contracted stump that follows an amputation below the knee for senile gangrene.

CLINIC OF DR. P. K. GILMAN

STANFORD UNIVERSITY HOSPITAL

AN INSTRUMENT FOR LOCATING AND DRAINING HEPATIC ABSCESS

THE surgical procedures made use of in treating abscess of the liver where the size of the purulent collection demands evacuation vary from simple aspiration to free drainage of the cavity.

We prefer to expose the liver by the abdominal rather than the transpleural route, as a less restricted field is secured than by the latter, and associated lesions may be recognized and, if necessary, treated at the same time.

With the liver exposed by whatever method, the first step in the actual operative work on that organ is exploration by means of a suitably large caliber and long needle. By this means we endeavor to locate the abscess and aspirate a sufficient quantity of contents to make certain the diagnosis.

The next step in the operation has heretofore varied, depending upon whether the operator advocates a one- or two-stage operation. We have evacuated the abscess at once by means of trocar and suction; other surgeons have preferred to pack and cause adhesions to form between liver and abdominal walls, the actual drainage being delayed one or two days.

It has been our aim to remove the abscess material with as little soiling as possible. This was done by withdrawing the aspirating needle and inserting an Ochsner gall-bladder trocar as near as possible along the track left by the needle. This step, with the withdrawing of one and the insertion of another instrument, was not ideal, as some escape of abscess material occurred at times, and not infrequently the insertion of the trocar in the right direction and to the correct depth was difficult. Relocation of the abscess was rarely necessary with the needle.

The instrument described and pictured here has been devised to allow a combination of the steps above described, and does away with the various objections to the one-stage operation, including especially that of changing instruments.

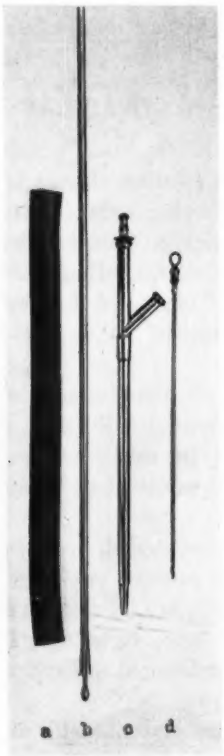

Fig. 159.

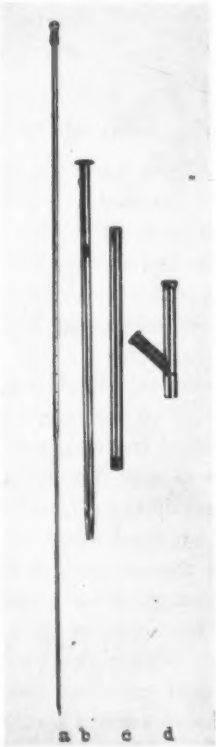

Fig. 160.

Fig. 161.

Fig. 159.—*a*, Drainage-tube; *b*, handle; *c*, trocar; *d*, needle.
Fig. 160.—*a*, Needle attached to plunger; *b*, *c*, and *d*, parts of trocar.
Fig. 161.—Needle and plunger being withdrawn through trocar.

Figure 159 shows the apparatus needed after the liver has been exposed and walled off from the rest of the abdominal cavity. Here the trocar shown is fitted with a hollow core drawn out to

a tapering end (Fig. 160, *b*) and having an opening 4 cm. from the upper end. This opening may be brought opposite the side tube of the trocar by revolving the core until marks on the upper end of the core and trocar correspond.

Within this core is fitted a solid rod marked in centimeters and ending in a threaded socket. This socket allows the rod to be screwed to the upper end of the aspirating needle (Fig. 160, *a*). When this is done the rod or plunger and attached needle may

Fig. 162.

be made to act as a guide along which the trocar and core are moved. As the needle is marked in centimeters as well as the plunger, the amount of progression needed is accurately determined. This is shown in Fig. 161.

Figures 162–167 show the instrument in use. In Fig. 162 the needle is being inserted into the abscess cavity. When the cavity has been entered and pus obtained by suction the rounded end of the needle is unscrewed and the assembled trocar attached

Fig. 163.

Fig. 164.

by screwing the plunger to the exposed threaded end of the needle (Fig. 163). The trocar is then forced along needle and plunger until the abscess cavity is entered as shown by the same number of centimeters of projecting plunger as of liver-contained needle (Fig. 164).

Plunger and attached needle are now withdrawn, leaving the trocar with its end within the cavity. The core is turned to make the opening correspond with the lateral opening of the trocar to

Fig. 165.

which has been attached a glass syringe. By means of this syringe (Fig. 165) the abscess cavity is emptied as completely as possible.

The core of the trocar is then removed and the upper portion of the latter unscrewed (Fig. 160, *d*), leaving the lower portion in place (Fig. 160, *c*).

The next step is to replace this steel tube by a rubber drainage-tube. The long hollow metal handle with expanding end is

fastened into the steel tube by a few turns of a knob at the upper end and the rubber tube slid along the handle. As the end of the rubber tube is molded like the end of a stomach-tube, it is readily slid along the steel tube within the liver substance until the cavity is reached. The lower end of the trocar is then withdrawn by the handle, the rubber drainage-tube being held in place.

Before closing the abdominal wound a small amount of gauze is placed to surround the rubber tube as it emerges from the liver

Fig. 166.

and is led out to the surface. This cares for any slight oozing from the liver wound and is removed in one or two days. As the various steps in the operation replace a previous smaller with a larger caliber object oozing is slight or more.

When the patient has been returned to bed a glass connection is used to attach the drainage-tube to a longer tube leading to a

Fig. 167.

bottle of antiseptic solution suspended from the bed frame. The largest part of subsequent drainage flows to this bottle and a minimum amount of dressings is required for the wound.

CLINIC OF DR. LEONARD W. ELY

STANFORD UNIVERSITY HOSPITAL

DUPUYTREN'S CONTRACTION

HERE is a printer and "lock-up" man, who says that the ring and little fingers of his right hand have given him trouble for about ten years. They have become more and more contracted until now they interfere seriously with his occupation, and he wants something done. It is this rather than pain which brings him to us. Otherwise he is in health. He has had the ordinary trouble with his teeth, he says, no trouble with his digestion, and no sore throat.

Examination shows the little finger slightly flexed at the metacarpophalangeal joint, and markedly flexed at the proximal interphalangeal. The same condition is present in the ring finger, but to a much less extent. The palm of the hand proximal to these fingers is ridged and folded. Tight bands run from these folds to the affected fingers. Forced attempts to straighten the fingers are vain, but no pain is elicited unless extreme force be used. There is no sign of active inflammation, *and the hand is not calloused.* All motions in the fingers, active and passive, not affected by the tight bands in the palm are free. In other words, there is no paralysis here. The teeth are in bad condition. They look as if they were abscessed at their roots.

This is a case of Dupuytren's contraction, a peculiar fibrosis and contracture of the palmar fascia. At first sight it appears to be a contraction of the flexor tendon (in this case the sublimis), but a tendon contraction would not give the peculiar wrinkling of the palm, and the tendons lie much deeper than these bands, as we shall see when we come to operate. Your first case you might mistake, but the picture is so peculiar that when you have seen one case, you will not err again.

What is the cause? Like almost every disease and deformity with which the orthopedic surgeon deals, this deformity has been ascribed to injury, usually to occupational trauma. It is quite an obvious explanation, and you may accept it if you wish, but it does not explain. Dupuytren's contraction is found most often in the ring and little fingers. Are they injured most often? Young persons injure their hands in their occupations, but they are immune, or practically so, to this deformity. Why? The deformity is usually bilateral, When one hand only is affected, the left hand is about as likely to suffer as the right. Those

Fig. 168.—Dupuytren's contraction.

whose occupations entail the maximum amount of trauma to the palm do not constitute the bulk of the patients. True, the deformity is seen most frequently among the laboring classes, but in the 20 cases which have passed through our clinic in the last few years, I find a barber, a piano tuner, a clerk, a brewer, and a tailor. Let me warn you against accepting obvious explanations, especially when you find them promulgated with such expressions as "There can be no doubt," "It is undoubtedly a fact," etc. If you will keep your minds open in your work, and will take the trouble to investigate, you will find that many undoubted facts in medicine are simply the expression of personal opinion.

The only treatment of this condition is operative. If you doubt this statement, try it out and see. I have never been able to correct the deformity in the slightest by splints. You can cause a slough of the fingers without stretching the fibrous tissue.

A number of operations have been proposed, and they must have been successful, for one finds little of failure mentioned in the text-books. Personally I have found the deformity extremely difficult to correct, and met with discouraging results in my earlier cases. Recently I have been more successful, but have had some mishaps. One patient, operated on by my resident surgeon, under my immediate personal supervision, lost his finger from gangrene. One patient lost a tendon from sloughing.

I think you will find that you will not be successful with the operation which consists of multiple small incisions to divide the adhesions between the skin and the fascia. The obstruction is not here. A more logical procedure is the dissection of the affected palmar fascia. The portion of the fascia deserving the most attention is the distal, not the proximal, as one would suppose. Pay particular attention to the vinculi which run especially to the proximal phalanges, but do not forget the blood-vessels which run at the side of the fingers.

With my assistant putting the affected fingers on the stretch I make my first incision, slightly curved, at the web of the fingers, in other words, *just as far distal as I can*. A second incision, about 3 cm. long, runs proximal to this over the most prominent portion of the contracted fascia. By dissection I lay back the two flaps, taking special care not to buttonhole the skin. Do not hurry with this. Now you see the band of fascia standing forth like a tendon. When you operate on your first case you will think it is a tendon and hesitate to divide it. Do not be afraid. The tendon lies much deeper and has a glistening sheen that is lacking here. We now dissect out and remove all this fascia which we can conveniently reach, and expect that the fingers can be straightened. They cannot be straightened. They rarely can be in these cases. I put my finger in the wound,

and find tense bands running down to the sides of the phalanges. I divide these, and my assistant, using a little force, tears loose the few remaining ones, and extends the fingers completely. I retract the flaps, and you see the glistening flexor tendons at the bottom of the wound, close to the bone. A few chromic gut sutures and a skin suture close the wound. Over a small dry dressing I place a tongue depressor splint to keep the fingers in extension until healing be complete.

One word more while the patient is being removed, concerning not only etiology but also treatment. I have said that practically all the patients with Dupuytren's contraction are of mature age. I have seen only one as young as the third decade. In our recent cases, that is, in all but one patient since we have been looking for it, we have found evidence of infection at the roots of the teeth, the so-called root abscesses, or presumptive evidence of previous infection—the absence of teeth. This patient has abscesses at the roots of his teeth revealed by the *x*-ray. The one exception was in the case of a medical student of twenty-five. He had infected tonsils. When these were removed his slight deformity ceased to increase. Many of the patients have second type arthritis. You may use these observations for what they are worth. As your first step in the treatment of Dupuytren's contraction I advise *removal of all dead teeth.*

HALLUX VALGUS

THE next 2 patients come to us complaining of pain in the great toe joint, the man, a laborer of forty-four years, on the right side, the woman, fifty-five years, of pain on the left. Let us have the woman wait outside for a few moments, and have the man stand up. What do you see? Answer: "His great toes turn outward." What else? Answer: "His great toe joints are prominent." "The skin over the right great toe joint looks roughened, reddened, and inflamed." Anything else? Well, let it go. We will return to that matter later. On palpation over the inflamed area on the right toe we find a slight increase of local temperature, and a slight impression of fluctuation. The area is exquisitely sensitive to touch, as you see. Motion of the phalanx in all directions on the metatarsal is limited. More especially you note that all attempts to correct the deformity passively and to bring the phalanx into line with the metatarsal are vain.

On the left side the deformity is possibly not so great, and the sensitiveness and swelling in the soft parts are less. Observe also that flexion and extension in this toe are perfectly free, but here again the phalanx cannot be brought into line with the metacarpal. By the way, what is this sensitive swelling over the joint called? Answer: "Bunion." What is a bunion? Answer: "An inflamed bursa." Partly right. It is an inflamed superficial bursa. We should not speak, for instance, of a bunion of the subacromial bursa. The term has generally been accepted as applying to bursa developed by irritation over the great toe joint alone. It is the natural sequence of the prominence of the joint caused by the hallux valgus. We do not look for it in the absence of this deformity.

We will have the man wheeled out and the woman brought in. She tells us that she had a bunion on the left foot for many years, with considerable pain recently. She has a bunion on each foot

but you note that she has also double hallux valgus. When she stands on a sterile towel you see that her feet are very flat. I have her sit down, and ask her to turn her foot well inward, that is, into the varus position. Now I ask her to bring it actively into the utmost possible amount of dorsal flexion. It does not come to a right angle. The normal range of motion is slightly

Fig. 169.—Hallux valgus. Note the varus position of the metatarsus, and the obliquity of the joint line between it and the cuneiform. Note also the irregular rarefaction in the head of the metatarsal—evidence of infection—the irregularity of the joint line, and the swelling of the soft parts. If one performed a resection of the head of this bone one would not be surprised by stiffness of the joint thereafter.

beyond the right angle. This is probably a congenital deformity caused by a short heel cord. A short heel cord is one of the causes of painful flat-feet, and is not without bearing upon the problem before us.

What is the cause of hallux valgus?

Answer: "Improper shoes." "Narrow and pointed shoes." "Short shoes."

Good. There cannot be any doubt that this is the correct explanation. Practically all authorities agree on the point. No case of hallux valgus, I believe, has ever been recorded in a person who did not wear shoes. It follows logically then, that as practically all persons in our civilization wear shoes which do not fit their feet, but which are pointed, narrow, and short, we all have bunions. Those who wear the worst shoes suffer most from bunions and hallux valgus.

Fig. 170.—Hallux valgus. Note the spreading of the metatarsals in this case also.

You have only to use your senses to perceive that I am talking nonsense. We have here an excellent example of the fallacy of the *post hoc* argument, so glaring that we wonder how it has made its way into the standard text-books. We are prepared to grant that faulty shoes are an element in the etiology, but for the ultimate cause we must look further.

If your attention had not been riveted on the distorted phalanx in these 2 patients, you would have noticed a peculiar twisting inward, so to speak, a varus position of the metatarsus. Look now at the roentgengrams of the feet. How plainly you

can see that while the second, third, fourth, and fifth metartarsals run practically parallel, the fifth metatarsal diverges from them, and runs forward and inward. In other words, the fifth metatarsal is in a position of varus. Why does this bone turn inward? Look carefully, and you will see that the joint between it and the cuneiform, instead of running transversely, runs obliquely, so that the metatarsal is set on the tarsus on a slant. The *x*-ray films of the other patient show the same thing. This metatarsus

Fig. 171.—Congenital adduction of the first metatarsal—varus. It is easily seen that whenever this patient begins to wear the ordinary shoe her phalanx will be pushed out of line with the metatarsal. A study of the film reveals irregularity of development in some of the epiphyses.

varus is probably the prime cause of the deformity we recognize under the term "hallux valgus." Occasionally you will not see this oblique joint, but a twist inward of the metatarsal near its base, similar to the bend of the tibia in a genu varum.

The production of the deformity is now readily understood. If a person with this peculiar congenital condition of the metatarsal never wore shoes, his great toe would turn inward through life, and he would not have a hallux valgus, but if he wore any shoes that were not monstrosities, they would push his prox-

imal phalanx outward. As soon as the phalanges are out of line with the metatarsal, the tendons act to increase the deformity. No post in the shoe, no splint will stop it. Remember one thing, however, that the shoe is not the prime, but the contributing, cause. All persons with hallux valgus wear shoes, but all persons who wear faulty shoes do not have hallux valgus.

Fig. 172.—Roentgenogram of feet of the mother of patient whose feet are shown in Fig. 171. Note the usual varus position of the metatarsal, and the irregularity of bone structure in its head—evidence of disease. This patient shows a squareness of outline of the end of the third metatarsal suggestive of Freiberg's disease.

Do not accept this because I say so, but try it out for yourselves.

All sorts of operations have been devised for the correction of hallux valgus. No orthopedic surgeon may hold up his head among his fellows who has not one of his own. Most of the operations work well in some cases, and badly in others. In medical meetings you will hear the matter discussed from almost every point but one. You will hear many personal opinions, but few facts. On one thing everyone seems agreed. The operation for hallux valgus is often followed by pain and stiff-

ness. Learned men dispute as to the cause of this pain and stiffness, and throw away the key to the problem. In your treatment of bones and joints use the same methods as in your treatment of the other organs. Learn all you can about the tissues with which you are dealing. If anything puzzles you, take the material you remove at operation to the laboratory, cut it up, study its anatomy, gross and histologic, and then compare your findings with your clinical history. If need be, try out your theories upon animals. If you have not time for this, then you must wait for someone else to do it for you. You will never get the answer by abstract reasoning. Let me give you a few hints on operating for hallux vulgus.

The logical point for attack is the base of the metatarsal. We have not had enough operations yet for me to tell you whether theory agrees with practice, as Ewald claims.

If you remove a piece of *normal* bone from the distal end of the metarsal, or from the proximal end of the first phalanx, ankylosis will not result, but if the joint is the seat of a chronic inflammation, and if, in operating, you set free infectious material previously locked up in the bone-marrow, then do not be surprised if pain and stiffness ensue, and your operation is a failure.

Before operating determine if the joint is the seat of chronic inflammation. The *x*-rays will often tell you this. If they show lipping and spurring, and the areas of necrosis in the spongy bone which we recognize as characteristic of second type arthritis, look for infection at the roots of the teeth, and for protozoa in the stools. If you find amebæ, give the patient a full course of neo-arsphenamin and emetin; if not, then administer the emetin alone. Sometimes you will find, in addition to the hallux valgus, a general sensitiveness and swelling of the metatarsophalangeal joints, with a normal Roentgen film. Then investigate the patient's tonsils and deep urethra. Possibly, when you have removed the chronic inflammation in these organs, the pain in the hallux valgus will subside to such an extent that the patient will refuse an operation.

Cases of slight degree sometimes can be relieved by the operation of removal of a piece of bone from the medial aspect

of the distal end of the metacarpal. Usually you will find it advisable to remove the head of the bone, but do not remove too much. Leave a piece of the head for weight bearing. The shortening of the metatarsal relaxes the pull of the tendons, and allows a proximal displacement of the phalanx, giving it a sort of brace against the second metatarsal.

Some operators advise resection of the phalanx, and claim good results. Try it if you wish. Mayo advises the interposition of the bursa, presumbly to avoid ankylosis. Ankylosis is not to be feared if the joint is normal, and the wisdom of employing a diseased tissue for interposition is doubtful in any case.

When you remove the end of the toe, remember that nature will cover it with fibrous tissue, and use it for an articulating surface. Do not leave it flat with jagged edges. Round it off, and make it approximately smooth, so as to save nature all possible trouble.

Ewald and Young, of Philadelphia, I believe, were the first to call attention to the metatarsus varus in hallux valgus. We have been on the lookout for evidence on the subject for some time. Let me show you an interesting case:

This girl of four years is brought to us on account of flat- and crooked feet. Her mother tells us that she has noticed the deformity for a year. She is flat-footed, pigeon toed, and knock-kneed. The great toes are in decided varus. The *x*-rays show beautiful metatarsus varus and irregularity in development of some of the toe epiphyses. Now we turn our attention to the mother. She has typical hallux valgus on both sides, and metatarsus varus. It will be interesting to watch the child as she grows up. I think when she begins to wear ordinary shoes she will have a pair of feet like her mother's. Hallux valgus is a familial deformity.

HAMMER-TOE

Our next patient is a physician of fifty-five years, who has consented to appear under the anesthetic. He complains of pain and deformity of the second toe of his right foot. The deformity has been present ever since he can remember, and has always occasioned him more or less discomfort, especially when he wears shoes which are not too large for him, or are stiff. Of recent years the deformity seems to have increased, though he is a crank on the subject of shoes, and has his shoes made from ideal lasts. He has suffered much from corns underneath and above the toe, and from corns on the neighboring toes as well. He tells us that the corns have recently troubled him more and more even though he has had his last filled out laterally, to provide extra room for the third, fourth, and fifth toes. He is sure, therefore, that the increasing deformity in the affected toe is pushing these toes laterally.

There are two suggestive things in the history: The first is that after suffering much and increasingly from a similar deformity in the second toe of the left foot, he had it amputated fourteen years ago. He had had a corrective apparatus made for one toe by an orthepedic surgeon many years ago. He could not tolerate it during the day. When he wore it at night it became so uncomfortable that he would reach down and remove it in his sleep. The second thing is that, on being questioned, while he has always been told the deformity was the result of wearing tight shoes, he remembers that his maternal grandmother used to speak of the affected members as "grandma's toes." He thinks she was afflicted similarly. His brother, of about the same age, who presumably wore about the same sort of shoes as he, never had any sign of the trouble. He is moderately flat-footed on the right, and his heel cord is a trifle short. In spite of the fact that his condition is supposed to be caused by tight shoes he has no sign of hallux valgus.

Just why the tight shoe, which ordinarily is accused of deforming the great toe, picks on the patient's second toe has never been explained to him.

The foot has been prepared for operation. Now that the dressings are removed, you will note that the second toe is superextended at the metatarsophalangeal joint, and flexed at the proximal interphalangeal. The deformity is very rigid, and, even by exerting considerable force, I am not correcting it in the slightest, though I can superextend the terminal interphalangeal joint. A tight band seems to run like a bow-string under the toe, holding it in its flexion, and reminding us somewhat of the patient with Dupuytren's contracture, but there is no wrinkling of the skin, nor any connection with the plantar fascia. See the corn over the proximal interphalangeal joint, evidently caused by rubbing the shoe. Under the end of the toe is another callosity, caused by the toe digging into the sole of the shoe. Besides the extension-flexion deformity a lateral element is present. The toe not only deviates laterally itself, but it is manifestly pushing the other small toes laterally as well. They also are well supplied with corns.

We have here a hammer-toe, and I am about to amputate it. However, I first divide the tense tissue which seems to be causing the deformity. The result is nil. I make a racquet incision, and disarticulate at the metatarsophalangeal joint. One or two bleeders I ligate, though this is probably not necessary. A couple of chromic gut sutures and a skin suture close the wound.

I think you will find that amputation is the most satisfactory treatment for hammer-toe. Jones, of Liverpool, advises against it, and recommends excision of the first interphalangeal joint, on the ground that the second toe is a support for the great toe, and that, when it is removed, a hallux valgus will develop. I need hardly tell you that the small toes are no support for anything, that they cannot prevent a hallux valgus when the metatarsal is in a varus position. You have already seen this today. However, it may be said that one man's theorizing is as good as another's. What we need are facts. I remove the

covering from the other foot. In spite of the fact that the adjoining toe was removed fourteen years ago, there is no suggestion of hallux valgus.

Learn to cultivate your powers of observation, and do not accept a thing that is manifestly absurd, even when it is put forward by high authority. We accept a thing readily if it is a "generally accepted fact," and thereafter seem to be blind as far as our powers of observation go. I show you this illustration of a case of hallux valgus from a recent text-book of orthopedic surgery. The author has swallowed the standard explanation of the deformity, and evidently cannot see that the metatarsal is in marked varus. He says that the patient would not have had his hallux valgus if he had a straight inside border of his shoe, while everyone of you can easily see that perpetual barefootedness was the only thing that would have prevented the formation of hallux valgus.

I have shown you three fairly common deformities of the feet, have presented my facts, and have told you the conclusions I draw from them. Take my facts for what they are worth, and draw your own conclusions. If you are interested, work the thing out for yourselves, and see where the truth lies.

CLINIC OF DR. LUDWIG A. EMGE

STANFORD UNIVERSITY HOSPITAL

THE SYMPTOMATOLOGY AND DIAGNOSIS OF VARICOSE VEINS OF THE FEMALE PELVIS

THERE is hardly any need to point out to the reader of these pages that in spite of our advanced knowledge of the disturbances of the female generative organs there still remains a large group of symptom complexes the obscure nature of which offers great difficulty to a correct diagnosis. Outstanding among them are those disturbances which follow in the train of upsets in the circulation of the female pelvic organs. There is little doubt that many ailments peculiar to the female sex have their foundation in changes of circulation. Most of these disorders arise in the venous channels of the pelvic viscera. There are two main reasons for this: The one is that we have to deal with a widely ramified group of veins intimately anastomosed with each other, but poorly supported by connective tissue, the other is that these vessels are subject to perpetual variations in blood-volume influenced by a host of factors.

My discussion deals with two groups of veins, the uterine, vaginal, vesical, and hemorrhoidal plexus, which drain into the inferior hypogastric vein and to a lesser degree into the ovarian vein, and the ovarian plexus which empties by way of the ovarian vein into the renal vein on the left and the vena cava on the right side. Elsewhere,[1] I have pointed out that the support of these veins is insecure at certain vulnerable points. This is most apparent in the ovarian circulation, less so in the uterine venous channels. It suffices to say here that the ovarian veins with their pampiniform plexus are supported merely by a delicate network of intrinsically interwoven strands of elastic

fibers and slender smooth muscle bundles attached to the peritoneum at one end and to the basal ligaments and the pelvic fascia on the other. Such a light support is therefore little suited to withstand prolonged vascular distentions. The uterine veins fare better in so far as their course is shorter and their supportive tissue firmer in texture. Only in the mesial half of the broad ligaments does this support become less secure. The vesical, vaginal, and hemorrhoidal veins benefit from a more secure support by virtue of the more intimate relation to the organs they drain. All of the veins spoken of here enter freely into an anastomosis with the veins of the peritoneum. Under stress the latter assume the function of a safety-valve.

Let us consider for a moment the mechanism of venous distentions as it affects the ovarian circulation. In its pelvic division, that is, between the uterus and the pelvic brim, the ovarian veins swing, so to speak, quite freely in a hammock made up mostly of peritoneum. Their course is, therefore, largely determined by the position of the uterus. Just before they reach the pelvic brim they become subject to pressure from the sigmoid and the cecum. At the brim they rise sharply, carrying often a large volume of blood. On the left their destination is the renal vein which they join at almost right angles without the interposition of a protecting valve. On the right they unite into a single vessel which empties into the vena cava. Backflow is prevented by a well-developed valve. This is the only valve in the venous circulation of the pelvis. Whenever stasis from whatever cause occurs in the ovarian circulation the pressure of the long column of blood centers in the most dependent portion, *i. e.*, in the poorly supported pelvic division. Should stasis occur in that group of veins which drain primarily into the inferior hypogastric vein, overdistention will be prevented for a long time, first, because the support is more secure and, second, because the flow can be diverted into the ovarian circulation. It stands to reason that the added strain on the ovarian circulation must aggravate an already existing condition. Presently the adjacent peritoneal veins are called upon for relief. The resulting pressure soon affects the widely ramified

network of nerve-fibers which closly follow the course of the blood-vessels and which bear an intimate relation to the peritoneum. Pressure upon these nerve-fibers is experienced as a deep-seated pain. Such pain is commonly translated into the ovary because of its anatomic relation to that area of the peritoneum which most commonly is affected by venous overdistention, hence the term "ovarian neuralgia." Progressive stasis means progressive nerve pressure. Therefore, pain may progress upward until it is experienced as a high lumbar backache or downward until it is felt as a bearing down sensation in the culdesac or even as a dull ache in the posterior surface of the thighs. As soon as pressure is relieved by the favorable recumbent position pain is lessened or disappears.

This rather general description of the relation of the veins in question to the mechanism of venous distention will serve in some measure for a better understanding of the resulting symptomatology.

Various terms have been suggested for chronic distentions of pelvic veins. They are varix, variococele, varicosities, varicose veins, pelvic varicocele, and varicocele of the broad ligament. Personally, I prefer the term "varicose veins" because the pathologic process is rarely confined to a single component of veins. If we designate the extent of the involvement confusion is easily avoided.

Varicose veins of the pelvic circulation in the female are most often observed between the ages of the late twenties and late thirties. They principally follow the height of the childbearing period. In my own experience I have found the disturbance as early as the eighteenth and as late as the forty-seventh year of life. It does occur in still older women. At present we must believe that the condition is always acquired. Congenital varicose veins of the pelvis have not been observed.

Pelvic veins are normally subject to variations in blood volume. This variation is physiologic in character and dependent upon sex emotions, menstruation, pregnancy, and the function of the lower bowel and bladder. The change from a physiologic to a pathologic distention takes place very

gradually and depends entirely upon the frequency and severity as well as length of the physiologic distention. It is difficult to create a definite dividing line between normal and abnormal.

There are a host of etiologic factors which must be considered as the exciting causes in this change from a physiologic to a pathologic state. For the sake of clearness I shall divide them into local and general causes and shall discuss the former first because of the greater importance.

It is generally agreed that pregnancy is the most important factor in the production of pelvic varicose veins. Subinvolution is chiefly to be blamed for this. Faulty involution of the uterus prevents the dependent pelvic circulation to return to a normal state. Venous stasis is thus unduly prolonged. After miscarriages and abortions this is more prone to happen because the progressive development of the uterus is cut short. Fatty changes occur more slowly. Hence, the means of restitution of the uterine structure to the normal is impeded. Its intimate circulation as well as that of the vicinity remains in a state of stasis. If sufficiently prolonged, a permanent distention of the venous components takes place.

Next in importance to pregnancy are the displacements of the uterus. This condition may be pre-existing or merely form a sequence to pregnancy. With the advent of uterine displacement pathologic stasis is aggravated and a vicious circle is formed for the following reasons. Stasis leads to increase in weight and size of the organ effected. (In other words hypertrophy and hyperplasia occur and ultimately end in a fibrosis. As this condition affects the uterus, cervix, and ovaries it has been commonly designated as chronic metritis, cervicitis, and oöphoritis. These terms are incorrect, since an inflammatory proces does not take place in these organs.) Displacements are followed by descent as the weight of the body of the uterus increases. The already disturbed adjacent veins experience torsion and kinking. More stasis occurs. The uterus and ovaries are stimulated to further hypertrophy. More displacement occurs. Thus, the process progresses until an advanced degree of fibrosis or menopausal atrophy breaks the ever widening vicious

circle. I do not wish to be understood that every displacement of the uterus is followed by venous disturbances. On the contrary, very many uterine displacements will never give rise to any disturbances. But I do believe that when a displaced uterus gives rise to symptoms they are ordinarily produced by an accompanying disturbance in the dependent venous channels.

Repeatedly the ovaries have been considered to be the cause of pelvic varicose veins simply because sclerocystic ovaries are so commonly found accompanying this condition. Therefore, their removal has been recommended as a cure. True enough, pelvic symptoms do disappear after oöphorectomy, but that is no proof. Since such a procedure usually is accompanied by more extensive destructive surgery the pelvic circulation is by necessity interrupted. The answer must therefore be sought in the destruction of the veins and not in the removal of ovaries. While these ovaries commonly have the aspect of a sclerocystic change they will assume a normal or near normal function as a more normal venous drainage is established. The sclerocystic process in these ovaries is the result of a stasis inviting hypertrophy and fibrosis, which principally affect the tunica and cortex. Rarely do we see the process sufficiently far enough advanced to prevent the maturing of all follicles, although retardation may occur. It is most interesting that a more normal function will take place as soon as the dependent circulation has been corrected.

In the service of the Stanford Women's Clinic as well as in private practice more than 100 patients suffering from pelvic varicose veins have been operated upon during a period of eight years. The incidence of oöphorectomy has been extremely rare during this period. Nevertheless, we have seen many sclerocystic ovaries. Experience has taught us to leave them undisturbed, because functionally they assume normal activities after correction of venous stasis.

Tumors of a benign nature and inflammatory changes commonly invite venous stasis. The resulting symptomatology is usually overshadowed by that of the exciting cause and therefore does not concern us here.

Frequently venous stasis can be traced to a faulty sex life, improper bowel hygiene, disturbed urinary function, and perhaps to endocrine disturbances manifested by an overstimulation of ovarian function. Sedentary habits merely form a contributory factor in so far as they invite some of the causes cited above. Of great importance is perineal relaxation as a cause for pelvic stasis. Similarly, deep cervical lacerations accompanied by hypertrophy of the cervix and relaxation of the basal uterine ligaments may invite a circulatory change. It would go too far to delve into the relation of posture and visceroptosis to venous disturbance. It suffices to say that they are to be considered in the etiology.

The general causes can be dismissed with few words because they are less common as etiologic factors. It has been stated that weakness of the right heart, disturbances of the lung and liver, abdominal tumors, renal disorders, gastro-enteritis and a host of other conditions may invite pelvic stasis. When such a state is reached it merely forms part of a general venous upset. Pelvic symptomatology becomes then extremely vague or is entirely overshadowed by the more apparent general disturbance.

It must be apparent from the preceding discussion that a multitude of symptoms can be produced by varicose veins in the pelvis of the female. Therefore, it is difficult to give a dogmatic symptomatology. Much depends upon intelligent and painstaking grouping of the complaints and findings in order to come to a conclusion. The deeper one delves into this subject the more difficult it becomes to lay down definite rules for making a diagnosis. If I, therefore, speak at times in an orthodox manner I must be forgiven, for I am attempting to clarify certain points in the reader's mind. It is nearly ten years since I began to study this subject. During this time about 90 patients have been observed in the operative service of the Stanford Women's Clinic and 27 in my private practice. The symptomatology varies greatly with each patient. Still, there are symptom groups which, when combined with other historical data and compared to local findings, will permit

preoperative diagnosis in 50 per cent. and a tentative diagnosis in another 25 per cent. The remaining 25 per cent. have to be diagnosed by surgical exploration.

I take it for granted that any physician of training and experience takes some kind of a history of his patient's complaints. In collecting data pertaining to the formation of varicose veins of the female pelvis it does not suffice to take a casual history. It is indispensible to collect all data painstakingly, observe the sequence of occurrences and study the relation of complaints to various functions in the daily life of the patient. If this rule is not followed religiously, the percentage of definite diagnoses will be very low.

Pain is the most common symptom. This pain is described by most patients as an indefinitely outlined, constant, achy feeling located deep in the extreme portions of the lateral regions of the pelvis. The character and behavior of this pain is in many respects similar to that experienced by men troubled with varicocele of the spermatic vein. Its severity depends definitely upon exertion, exercise, sex emotion, premenstrual engorgement, and constipation. Rest in the recumbent position alleviates or gives complete freedom from it. It has been said that this pain occurs most often in the left half of the pelvis. This has been attributed to pressure by the sigmoid on the ovarian circulation. In our own material, bilateral is more frequent than unilateral pain, but the preponderance of left-sided pain is apparent in the group.

Next to pelvic pain backache is the most frequent complaint. Backache is such a vague and common complaint of many women that one must exercise the greatest care in analyzing the type of backache found in connection with pelvic varicose veins. Thus we learn that this backache manifests itself in the early stages as a sensation of fatigue in the sacral and low lumbar regions. It is diffuse in character and appears during the morning hours. As the day goes on its intensity increases and commonly subsides speedily as the patient assumes the recumbent position. In the absence of tumors or inflammatory masses this sequence becomes quite significant since the backache

produced by the latter is seldom relieved by complete rest. Sexual emotion and premenstrual engorgement commonly aggravate the backache under discussion. It increases in severity according to the chronicity of pelvic stasis. It is most significant that this backache progresses upward in due time. Ultimately it localizes in the sacral and the renal regions. Since this backache is due primarily to pressure on sympathetic nerve fibers its character is at all times diffuse and apparently entirely out of proportion to the local area involved.

Leukorrhea or hydrorrhea is another important symptom. It is merely a manifestation of congestion and not of infection. The glands of the endometrium and of the cervix, and in extreme conditions, the glands of Bartholin and Skene's glands, are excited to hypersecretion by the constant venous stasis. This symptom is aggravated as the uterine glands increase in numbers and size during the progressive process of hyperplasia and hypertrophy. Cervical erosions result from maceration of the ever-present pool of secretion in the lacuna and a still larger field of secretion results. Chafing of the external genitalia is merely the result of maceration of the surface epithelium. Local treatment is futile until the underlying cause is corrected. If infections occur, they are superimposed because of a suitable medium in which to grow.

So-called ovarian neuralgia is another common complaint. Elsewhere,[2] I have pointed out the relation of the ovary to that area of the peritoneum which carries a large number of veins widely anastomosed with the ovarian circulation. Whenever these veins or those of the pampiniform plexus become unduly distended the resulting pain is commonly translated into the ovary. In the usual bimanual examination of the peritoneal area spoken of, the pampiniform plexus and the ovary are palapted simultaneously. The impression gained is that the pain reproduced by pressure actually centers in the ovary. One is still more easily misled when the ovary is found enlarged, as is so commonly the case. In order to obtain more reliable information from local palpation I have accustomed myself to make combined rectovaginal abdominal examinations. In this way

one can manage to palpate the broad ligament with the middle finger and the ovary with the index-finger. With a little experience and practice one then can localize the area of tenderness much more precisely than one could with the conventional bimanual examination. Nevertheless, at times even this procedure will fail to shed additional light, because vascular tenderness has become general and the ovary is actually tender.

Menstrual irregularities and dysmenorrhea frequently appear in the course of prolonged pelvic stasis. In a classical case the menstrual cycle occurs at increasingly frequent intervals. Next we find that the menstrual flow is prolonged. Ultimately the amount of flow is increased until it assumes the nature of menorrhagia. Bilateral deep-seated pains, of the character spoken of, appear days before the menstruation or, if they exist already, are definitely aggravated. The same is true of backache. The explanation for the disturbances in the menstrual cycle must be sought both in the overstimulation of the ovaries by congestion and the increasing menstrual surface produced by hyperplasia of the endometrium. Ultimately the menstrual cycle becomes irregular and the flow more scanty. Fibrosis interferes then with the maturing of the graafian follicles as well as with the proper blood-supply of the endometrium. A careful search of the menstrual history may thus be of greatest help in gaining information pointing to venous disturbances.

There are several minor complaints we hear of occasionally. Among these dyspareunia, frequency of urination, and "leg-ache" are the most common. The type of dyspareunia encountered does not manifest itself only by a vague ache deep in the pelvis during the sexual act, but is marked by the prolonged persistence of this sensation for some hours after the act. It merely means that pelvic congestion is suddenly and enormously increased and since there is usually a suppression of libido as a result of fear of pain, congestion is not relieved by a normal relaxation. Frequency of urination in the absence of abnormal urinary findings and usually not accompanied by nycturia means an involvement of the vesical plexus. "Leg-ache" expresses itself by a tired feeling along the posterior surfaces of the thighs and

must be taken as an expression of advanced pelvic stasis making pressure upon the obturator nerve.

It is at once apparent that with the great variety of symptoms and the often coexisting disturbances of the pelvic organs an accurate diagnosis is difficult at all times. No doubt there are many conditions which may be simulated by pelvic varicosities. I only mention appendicitis, salpingitis, oöphoritis, metritis, vesical and ureteral disturbances. Careful investigation of blood, urine and temperature will be of the utmost help by their negative results. I call special attention to the blood-picture which has been studied throughout this series of patients. It very seldom varies from the normal unless an accompanying inflammatory condition exists elsewhere in the body.

In examining patients suspected of pelvic varicose veins, it is essential not only to employ the bimanual rectovaginal abdominal palpation but also to alter the position of the patient during such an examination. In the dorsal position the pelvic veins naturally are relieved of their distension. Unless the disturbance is very pronounced and the patient a thin person little or nothing will be made out by the palpating fingers but areas of tenderness. Such a finding is merely suggestive of vascular tenderness provided inflammatory or tumor masses are absent. It is therefore necessary to let the patient assume a sitting position slowly while the broad ligament is being palpated. During the change of position one can frequently feel the increasing size of the vascular structures until after a minute or so the broad ligament presents itself to the examining finger as a boggy, tender structure. I must confess that it is extremely difficult to map out definite varicoceles. In a great many examinations I have been able actually to distinguish separate varicosities only a few times, and then felt doubtful as to the findings. At times even the change in the size of the broad ligaments cannot be made out. Then nothing remains but to localize the areas of tenderness which under certain conditions suggest vascular disturbance.

Some diagnostic information may also be gained by a careful examination of the color of the vaginal mucosa. A bluish,

thickened, excessively moist vagina is indicative of stasis. Vulvar and vaginal varicosities may furnish further information. Similarly, the size and consistency of the uterus may give us some help. In the early stages of chronic pelvic stasis the uterus resembles early pregnancy to the point of a positive Hegar sign. In the later stages the uterus is large, bulky, and hard. In displacements a properly fitted pessary may give diagnostic aid in so far as it raises the level of the uterus, puts the broad ligaments on a stretch and thus provides better drainage for the pelvic vein. If pain disappears after such a procedure, one may safely assume that the disturbance is circulatory in nature.

Tubal insufflation is of distinct value in excluding suspected non-palpable inflammatory lesions of the tubes. By no means should the diagnosis be deferred until the abdomen is opened. The appearance of the tubes and the fundus, especially when the latter is retrodisplaced, suggests an inflammatory reaction, while in reality this is due to venous stasis and local edema.

It is needless to say that radiologic and cystoscopic evidence must be obtained if the appendix or the urinary tracts have to be excluded. In fact, one should call every agency into action that might shed additional light. Should exploration have to be resorted to I warn against placing the patient in a Trendelenburg position before the pelvis is carefully inspected. Unless this rule is observed varicose veins of the female pelvis will be overlooked because they are relieved from distention as soon as the pelvis is raised above the level of the shoulders.

In leaving this subject I wish to point out that it has been the storm center of medical discussions at various occasions. Judging from the literature it has experienced a number of enthusiastic revivals, but seemingly has dropped into obscurity after a short span to be pulled out into the light again a decade later. With the exception of some foreign reports, mostly small series of cases have been published. Enthusiasm seems to have cooled after further experience had been gained. I have often wondered about the reason for this as I have also wondered about the dirth of information in our modern American text-

books. Perhaps I assume too much in stating that I believe the answer must be sought in the obstacles that make a diagnosis of this condition so difficult. Varicose veins of the female pelvis are not uncommon, judging from our experience at the Stanford Women's Clinic and in private practice. Since the disturbance can be successfully overcome in most instances, it deserves to be studied more widely and should be looked for more often. It is for this reason that I again call attention to this interesting subject.

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CLINIC OF DR. HENRY A. STEPHENSON

STANFORD UNIVERSITY

A STUDY OF VITAL STATISTICS WITH SPECIAL REFERENCE TO THE OBSTETRIC SPECIALIST

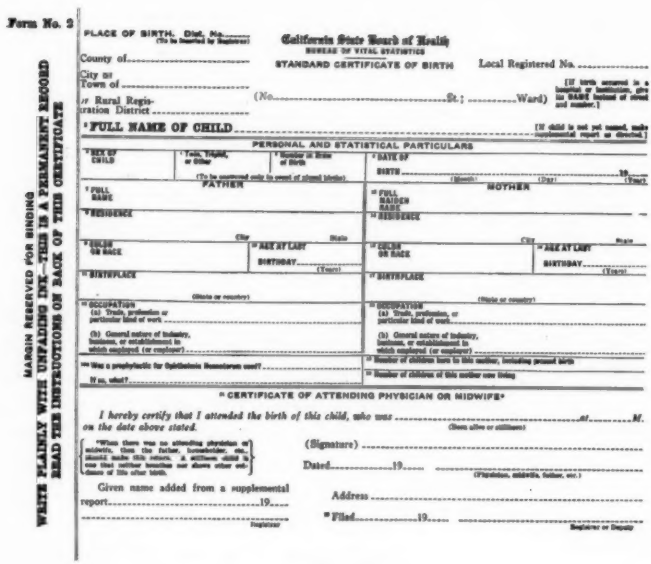
THE Certificate of Birth required by the State of California for each child born in the State furnishes much data for study by those of us interested in obstetrics. From it we may learn whether or not the birth occurred in the home or hospital, the sex of the child, whether single or plural births, the date of birth, the full name of the parents with their nativity, their occupation, the number of children born to the mother and the number now living, whether a prophylactic for ophthalmia neonatorum was used and, if so, what; whether the child was born alive, and, finally, the name and address of the attendant at the confinement. (See page 450.)

Through the courtesy of the Chief Health Officer of San Francisco, Dr. Wm. Hassler, access was had to the birth records of the City and County of San Francisco. Two thousand records were reviewed and the results tabulated by one of our former students, Dr. A. K. Chorbajian. Similar analysis was made of 500 records in Colusa County, 1000 in the City of Fresno, and 1000 in the County of Fresno by Dr. R. M. Nesbit. These results were incorporated in theses required for the medical degree from Stanford Medical School. I wish to express my appreciation for permission to use these tables which will furnish the basis of this discussion.

CHART I

COMPARISON OF HOME AND HOSPITAL CONFINEMENTS

	Total.	Home.	Percentage.	Hospital.	Percentage.
San Francisco.....	2000	582	29.1	1418	70.9
Fresno and Colusa.....	2500	1983	79.3	517	20.7



Form No. 2

PLACE OF BIRTH. Dist. No.
(To be inserted by Registrar)

California State Board of Health
BUREAU OF VITAL STATISTICS
STANDARD CERTIFICATE OF BIRTH

Local Registered No.

County of
City or Town of
or Rural Registration District
(No. St.; Ward)
[If born elsewhere than in a hospital or institution, give in PLACE column of record and number.]

* FULL NAME OF CHILD
[If child is not yet named, make supplemental report as directed.]

MARGIN RESERVED FOR BINDING
WRITE PLAINLY WITH UNFADING INK—THIS IS A PERMANENT RECORD
READ THE INSTRUCTIONS ON BACK OF THIS CERTIFICATE

PERSONAL AND STATISTICAL PARTICULARS

* SEX OF CHILD	* Twin, Triplet, or Other (To be answered only in event of plural births)	* Number in order of birth	* DATE OF BIRTH (Month) (Day) (Year)
FATHER			MOTHER
* FULL NAME			** FULL MAIDEN NAME
* RESIDENCE (City / State)			** RESIDENCE (City / State)
* COLOR OR RACE	** AGE AT LAST BIRTHDAY (Years)		** COLOR OR RACE / ** AGE AT LAST BIRTHDAY (Years)
** BIRTHPLACE (State or country)			** BIRTHPLACE (State or country)
** OCCUPATION (a) Trade, profession, or particular kind of work			** OCCUPATION (a) Trade, profession, or particular kind of work
(b) General nature of industry, business, or establishment in which employed (or employer)			(b) General nature of industry, business, or establishment in which employed (or employer)
*** Was a prophylactic for Ophthalmia Neonatorum used? If so, what?			** Number of children born to this mother, including present birth / ** Number of children of this mother now living

* CERTIFICATE OF ATTENDING PHYSICIAN OR MIDWIFE*

I hereby certify that I attended the birth of this child, who was (Given name or surname) *at* M. *on the date above stated.*

*When there was no attending physician or midwife, then the father, householder, etc., should make this return. A stillborn child is one that neither breathes nor shows other evidence of life after birth.

(Signature)

Dated 19 (Physician, midwife, father, etc.)

Given name added from a supplemental report 19

Address

Registrar

* Filed 19

Registrar or Deputy

INSTRUCTIONS

1. **THIS IS A LEGAL DOCUMENT. IT IS A PERMANENT RECORD**
2. **A birth certificate must be filed for every child born. In case of plural births a separate certificate must be filed for each child.**

   A stillbirth must be registered both as a birth and a death. If, however, the foetus has not advanced to the fifth month of uterogestation no certificate need be filed.

   Midwives are prohibited by law from signing death certificates of stillborn children. In case of a stillbirth with no physician in attendance, refer the case to the coroner.
3. **All information called for on this certificate must be given. Read the printed matter carefully.**
4. **THE PHYSICIAN in attendance must file the birth certificate with the local registrar of the registration district in which the birth occurs. If there was no physician in attendance, then the midwife or person acting as such, must file the birth certificate with the local registrar.**

   If no person attended the birth, then the father or mother must file the birth certificate with the local registrar.
5. **In Freeholders Charter Cities the health officer is the registrar.**

   In other cities of 5,000 inhabitants or more at the last census, the city clerk is the registrar.

   The balance of each county is divided into rural registration districts, with the registrar especially appointed. It is customary for city clerks to act as registrars for rural districts. Information concerning district boundaries can be obtained from the State Board of Health, Bureau of Vital Statistics, Sacramento.
6. **SIGNATURE: This certificate must bear the ACTUAL SIGNATURE of the physician, midwife or person acting as midwife. Typewritten and rubber stamp signatures are not legal and can not be accepted.**
7. **If the child is not named before this certificate is filed, a SUPPLEMENTAL REPORT OF BIRTH must be filed with the local registrar as soon as the child is named. Secure the blank from the local registrar.**
8. **Fill out the certificate (except signatures) with typewriter if possible. Otherwise WRITE PLAINLY with black ink.**

   BE CAREFUL in spelling names. Make them legible.

CALIFORNIA STATE BOARD OF HEALTH

Bureau of Vital Statistics

The relative percentages of patients delivered in the hospital and in the home are shown in Chart I (page 449). Over 70 per cent. of the confinements in San Francisco are conducted in hospitals or maternity homes, while in the smaller city of Fresno and the rural districts of Colusa and Fresno Counties the conditions are practically reversed. This is not difficult to understand when we analyze hospital facilities in San Francisco. The clinics of the two University Hospitals and of the splendid County Hospital offer excellent obstetric service at very moderate rates or entirely free, depending upon the ability of the patients to pay. To patients in moderate circumstances many private maternity homes and hospitals are open and the rates are such that it is easier and more economical to be confined in the hospital. In rural districts or in small towns where hospital facilities are lacking or inadequate, home confinement is the rule.

CHART II

ANALYSIS OF ATTENDANTS AT CONFINEMENTS

		Per cent.
In San Francisco:		
General practitioners	1173	58.65
Obstetric specialists	635	31.75
Midwives	174	8.70
Unattended	18	0.90
In Fresno and Colusa:		
General practitioners	2061	82.44
Unattended	374	14.96
Midwives	65	2.60

The attendants at these confinements were placed in three groups: general practitioners, obstetric specialists, and midwives. Some difficulty was experienced in selecting the second group and in Fresno and Colusa no differentiation was attempted; all physicians were grouped under "practitioners." In San Francisco the term "specialist" was used in cases where the physician limited his practice to obstetrics exclusively or to obstetrics and one closely allied specialty such as gynecology or pediatrics. In this group also were placed those patients delivered in the obstetric clinics of the two universities.

Reference to Chart II on page 451 will show that in the City of San Francisco the obstetric specialist delivers 31.75 per cent. of all patients. This is, roughly, 1 in 3. This percentage is certainly higher than has been reported previously, but we believe the figure to be approximately correct, as the public more and more demands the best service in confinement cases. In addition, obstetrics as a specialty is being awarded its just due by the profession. In rural districts the bulk of the work still goes to the general practitioner, as few communities can justify the presence of a physician who limits his work exclusively to obstetrics.

The midwife delivers every twelfth woman confined in San Francisco. Analysis of the records shows that her work is almost exclusively among the foreign-born population. As this population is becoming relatively smaller, the inference is that fewer patients will be delivered by the midwife.

In analyzing these birth records we were surprised to find that the number of stillbirths was remarkably constant regardless of the locality in which the birth occurred or of the attendant at the confinement. Chart III shows the percentages of stillbirths, which average 4.1 per cent. for the entire series.

CHART III

STILLBIRTHS

Attended by	San Francisco.	Fresno City.	Fresno County.	Colusa.
	80— 4.00%	41—4.1%	39—3.90%	22—4.4%
General practitioners....	57—71.25%			
Obstetric specialists....	18—22.50%			
Midwives.....	4— 5.00%			
Unrecorded.....	1— 1.25%			

In the San Francisco series the attendant was noted and we find the obstetric specialist was present at 22.5 per cent. of all the stillbirths. There is some improvement here in his record, however, for while he delivers every third patient he is credited with every fifth stillbirth. This improvement can be easily explained when we study the next chart.

CHART IV

CAUSES OF STILLBIRTHS

	San Francisco.	Fresno and Colusa.	Total.
Unknown	23	31	54
Prematurity	12	16	28
Dystocia	10	7	17
Toxemia of pregnancy	7	1	8
Congenital syphilis	5	25	30
Breech extraction	5	0	5
Maternal nephritis	3	1	4
Placenta ablatio	3	2	5
Placenta prævia	2	0	2
Maternal influenza	2	0	2
Congenital defects	5	4	9
Hemorrhage from cord	1	0	1
Prenatal injury	1	0	1
"Fright"	1	0	1
Birth injuries	0	14	14
Debility	0	1	1
	80	102	182

In Chart IV will be found the causes of these stillbirths as given on the death certificates. An analysis of this chart shows the cause of death unknown in 54 cases—the largest group. This reflects on the profession to some extent, as the cause of death can usually be determined by autopsy. Sentiment should never prevent the attending physician from making every effort to obtain a postmortem examination. We were surprised to learn that in the San Francisco group only 3.5 per cent. of these children had postmortem examinations. The pathology departments of the two universities are so well organized and equipped that we should insist upon a very large percentage of autopsies in such cases.

Congenital syphilis forms the next largest group, with 30 cases—about 16 per cent. When such advances have been made in the diagnosis and treatment of lues, this is indeed too high. Routine Wassermann examinations and intensive treatment where the disease exists should bring this percentage much lower. A helpful factor consists in educating the patient to apply as early in pregnancy as possible to her physician or clinic, and then after explaining to her the necessity for treatment

where indicated insist that she follow to the letter the routine outlined for her. What can be done in this class of cases has been shown by much work recently reported from the clinic of Williams, in Baltimore.

Prematurity comes third on the list of stillbirths. Since the period of gestation is not stated on many of the death certificates, it is impossible to draw definite conclusions, but here again prenatal care and intelligent professional supervision may materially reduce the mortality. Occupation may affect the period of gestation and it would be interesting to determine if the stillbirths due to prematurity vary materially between those patients who indulge in hard physical labor for a portion of their pregnancies and those who are more fortunate in this respect. This could not be determined from the data available.

Combining dystocia, birth injuries, and breech extraction, we find a total of 36 deaths. This again is 20 per cent. This certainly reflects somewhat on the professional ability of those caring for confinement cases. To attribute every fifth stillbirth to one of the above causes seems to me to reflect on judgment and technic. Certainly, among obstetric specialists, we expect the rate to be less.

The toxemias, to a large degree avoidable, furnish in this series 12 deaths. Since the infant's death is most often due to prematurity in cases of toxemia in the mother, no doubt some of these could be placed in that group. Once again I would urge upon you the importance of following your obstetric patients with the utmost diligence and care and thereby avoiding oftentimes a toxemia or certainly controlling it in most instances until a viable child may be obtained.

Under accidents of pregnancy, such as placenta ablatio, etc., we have 8 cases. These cases are almost unavoidable and the mortality is exceedingly high, even when the best possible facilities are available and the patient under the most expert care.

The same applies to the congenital defects—9 cases. Death in these cases is due to a condition beyond the control of the attendant and, therefore, the mortality in this group will probably not be lowered by any means now at our disposal.

In summarizing this group we believe the percentage should be lower. The toxemia, syphilis, prematurity, and birth injury groups are, to a degree, preventable. Every effort should be made in educating the public and our medical students to regard these groups as such. The accidents of pregnancy and the congenital defect groups are more or less beyond our control and little can be done to prevent them. However, consolation and encouragement come to us in that they are indeed very small groups.

CHART V

DEATH FIRST TWO WEEKS

Attended by	San Francisco.	Fresno City.	Fresno County.	Colusa.
	51	14	31	9
General practitioners	34—66.66%			
Obstetric specialists	15—29.42%			
Midwives	1— 1.96%			
No record	1— 1.96%			

AGE AT DEATH

First hour	7
First day	27
Second day	5
Third day	1
Fourth day	1
Fifth day	2
Sixth day	1
Seventh day	1
Tenth day	1
Eleventh day	1
Twelfth day	2
Not stated	2
	51

Having become interested in the death rate in these groups, we attempted to find the number of deaths during the first two weeks of life. The death records were then consulted for this same period and the infant deaths checked against the birth records. Chart V shows the results. The number was smaller than the stillbirth number. In San Francisco we find the percentage attended by obstetric specialists to be 29.4. Many death certificates bore the signatures of pediatricians who had

been called in by the obstetric attendant, so that these figures mean less in our effort to form an opinion of the status of the obstetric specialist than those analyzed above.

The age of these children at death reveals that 66.66 per cent. died within the first twenty-four hours. This to us means that most of them never really had much chance of living. Analysis of the causes of death (Chart VI) shows again that prematurity is the main cause. Birth trauma is second. These two explain 50 per cent. of all the deaths occurring in the first two weeks of life. The remarks made under prevention in stillbirths again become applicable here.

CHART VI

CAUSE OF DEATH FIRST TWO WEEKS OF LIFE

	San Francisco.	Fresno and Colusa.	Total.
Prematurity	21	11	32
Birth trauma	7	11	18
Atelectasis	4	0	4
Hemorrhagic disease	3	3	6
Inanition	3	4	7
Maldevelopment	4	6	10
Placenta prævia	2	1	3
Syphilis	1	4	5
Pneumonia	0	5	5
Infection	0	2	2
Dystocia	0	2	2
Other causes	6	5	11
	51	54	105

This study then has brought out several facts concerning the obstetric specialist. First, in the City of San Francisco we find that he is the attendant at 31.75 per cent. of all deliveries. Second, that of all the stillbirths his percentage is 22.5, a very distinct improvement. Third, that of those deaths occurring in the first two weeks of life his percentage is 29.5. When we consider that many of his patients are seen in consultation, oftentimes after labor is well advanced or attempts at delivery have been made, his record seems more satisfactory. Much remains to be desired, however, when we analyze the causes of death in both groups. As has been suggested, a large percentage

of these deaths seems preventable, particularly those due to birth injuries, syphilis, toxemia, and prematurity. The physician who accepts the responsibility and obligation attendant to an obstetric patient must give intelligent and conscientious prenatal supervision and be prepared to care for any obstetric emergency which may arise at the time of labor. Anything less than this brings discredit to his profession and oftentimes needless suffering to his clientele.

CLINIC OF DR. ALICE F. MAXWELL

FROM THE WOMAN'S CLINIC, UNIVERSITY OF CALIFORNIA HOSPITAL

INVERSION OF THE UTERUS

INVERSION of the uterus is not a rare displacement, yet the complication is of interest because it may be followed by a high maternal mortality. This displacement may come about from a variety of causes. Thus Thorn in 1911, reviewing the literature of the world, was able to collect 641 cases which, grouped according to etiologic factors, showed 81.2 per cent. were of obstetric origin, 13 per cent. resulted from uterine tumors, 2.2 per cent. occurred postmortem, 2 per cent. were idiopathic, 1.6 per cent. followed abortions or premature labors.

Frequency.—It is evident from the above that inversion is most often found associated with pregnancy, yet the infrequency of inversion in the obstetric group can be seen from the following statistics compiled from various European clinics (Cohen):

1 in 17,000 labors (Jardine)
0 in 20,000 labors (Winckel)
1 in 250,000 labors (Braun)
1 in 100,000 labors (Denham)
0 in 250,000 labors (Beckman)
1 in 190,000 labors (Madden)
1 in 127,000 labors (Jones)
1 in 2,000 labors (Kehrer)
1 in 100,000 labors (Ahlfeld)
1 in 400,000 labors (Zangemeister)
1 in 35,000 labors (Wilponer)

1 in 1,440 (Ferri and Lorini)
1 in 5,000 (Englemann)
1 in 6,300 (Chetenham Dis. Ass.)
1 in 100,000 (Aveling)

Average: 1 in 123,364 full term

In our clinic at the University of California Hospital inversion after labor occurred in 1 in 6500 labors. Thus it is apparent that, even in large clinics, this displacement is a medical curiosity.

Types of Puerperal Inversion.—Inversion of the uterus usually begins as a depression of the fundus which progresses. In rare instances, however, inversion may begin as a lateral depression or the tightly contracted fundus may prolapse through a relaxed and dilated cervix. Inversion may vary in degree from a small dimple of the fundus to descent of the fundus to the cervix, or complete descent of the fundus through the cervix and, finally, in extreme cases, to prolapse of an inverted uterus and vagina. Inversion of the uterus may be acute or chronic, the acute stage being recognized usually after the termination of the third stage of labor; chronic inversion represents an end stage of an acute obstetric inversion, or may come about slowly as a result of tugging of a pedunculated tumor mass emerging from the cervix and, under these conditions, is not necessarily associated with pregnancy.

Etiology.—Except in the spontaneous variety which occurs only with completely relaxed uterus, inversion of the puerperal uterus results usually from errors in the obstetric art. The factors which are necessary for production are, either pressure from above on the fundus or traction from below on the cord. A localized atrophy or undue thinning of the uterine wall will predispose to the displacement. Numerous exciting causes may be the factors which cause the complication, the most common of which are fundal implantation of the placenta, improper Credé maneuver, short umbilical cord, manual extraction of placenta, removal of uterine pack after labor, sudden increase of intra-abdominal pressure, and erect position during labor.

The common site of implantation of the placenta is in the upper active segment of the uterus, on either the anterior or posterior uterine wall. With a fundal implantation of the placenta, the weight of the placenta may easily cause a depression of this area, which, *per se*, may be sufficient to begin the invagination. This emphasizes the importance of recognizing the significance of any indentation of the fundus during labor and of avoiding pressure over this area.

The Credé method of separating and expressing the placenta has been extensively employed and is of definite value in properly

selected cases. If a placenta does not separate from the uterine wall after a period of one-half to one hour, or in the presence of hemorrhage during the third stage of labor, we may hasten or bring about this separation by making pressure on the fundus uteri in the direction of the birth canal. Before exerting pressure on the fundus, however, it is essential that the uterus be firmly contracted and that the palms of the hands be used to make firm, even pressure in the direction of the superior strait, rather than to press the fundus between the thumb and one or two fingers. To minimize the danger of an indentation the force should not be exerted constantly on the same area in executing a Credé.

The importance of a short cord in bringing about inversion is self-evident and emphasizes the necessity of avoiding traction on the cord. Following delivery of the head, we must determine the presence or absence of coils of cord about the child's neck. With a normal length of cord, it is usually a simple matter to slip one or two loops over the child's head; with a short cord, this may be difficult or impossible. If gentle traction does not permit the removal of the enveloping coils, the cord must be cut rather than make any considerable degree of traction.

The maintenance of uterine contraction following removal of an adherent placenta or uterine pack will tend to prevent an invagination of the uterine fundus. The hand or pack should be removed slowly. A hand on the fundus through the abdominal wall will determine the tonicity of the uterine musculature, which can be augmented by gentle massage.

Sudden increase of abdominal pressure may be the exciting cause in some instances, *i. e.*, coughing, sneezing, or assumption of an upright position immediately after delivery. Such abrupt force exerted on the fundus after labor may be sufficient to invert the uterus.

Time of Inversion.—The acute condition is so frequently associated with violent symptoms as to be recognized at once. Jones, analyzing 191 obstetric inversions, found 19 were diagnosed at once after second stage, 44 cases after delivering placenta, and 141 cases within twelve hours after delivery of

placenta. Another group of 158 cases were diagnosed later as shown by the following figures: 67 within six weeks after labor, 62 within six months after labor, and 40 after one year. This latter table, however, does not indicate the time of occurrence of the inversion and may be interpreted as lack of diagnostic acumen of the obstetric attendant, or as examples of acute inversion without symptoms.

Immediately after delivery, when the cervix is patent, the fundus is most likely to invert, yet McFarlane states that inversion may occur as late as five days postpartum, and, in the patient under our observation, it did not occur until twenty-four hours after delivery, when a blood-clot and small piece of placenta were expressed by pressure on the fundus.

Symptoms.—The symptoms following acute puerperal inversion are shock and hemorrhage. Shock may occur quite independently of bleeding and is not in proportion to the blood loss; it is usually attributed to the abrupt change of pressure in the intra-abdominal vascular system following displacement of the fundus and also to the sudden stretching and tension of the peritoneal covering of the uterus. This emphasizes the necessity of making abdominal palpation to confirm the position of the uterus as an abdominal organ in every patient who goes into shock after delivery, even if no exciting factors for the production of inversion have been active. Hemorrhage is a constant finding. It may be very marked in the acute cases and persists as long as the inversion is present. In the chronic cases the prolonged bleeding gives rise to a marked secondary anemia.

If the bleeding is not pronounced, the condition may not be diagnosed for months or even years after the inversion has occurred. If, however, adequate postpartum supervision and examination are carried out routinely on every woman, a diagnosis is always made promptly and proper treatment instigated early which will facilitate replacement.

In the chronic cases, in addition to abnormalities of bleeding, the woman frequently complains of a sensation of dragging and weight in pelvis. Reflex nervous symptoms are commonly present. At times a loop of bowel may become adherent or

caught in the inversion funnel and give symptoms of intestinal obstruction. Finally, the resistance of the woman is gradually depleted owing to the chronic sepsis which attacks the exposed lining membrane of the uterus, and cachexia and toxemia complicate the picture.

Treatment.—The treatment will depend upon the duration of the inversion; if a diagnosis is made as soon as the displacement occurs, reposition is usually a simple matter; however, if weeks or months have elapsed before attempts at correction are made, simple methods are usually quite ineffectual and surgical procedures will be necessary. In the incomplete type of inversion in which the fundus has prolapsed through the cervix, the latter structure usually clamps down upon the uterus, which prevents reposition. In the chronic complete type of inversion the peritoneal covering of the inverted funnel often becomes shrunken and rigid, or the apposing surfaces of peritoneum may become adherent, all of which prevents reposition by simple taxis.

The methods which are employed for the treatment of inversion are grouped under posture, taxis, or surgery.

In acute puerperal inversion, in the absence of shock, attempts to replace the inverted fundus should be made at once. If the patient, however, shows symptoms of shock, it is necessary at first to combat this complication and defer attempts at reposition.

The patient should be placed upon a flat surface with the buttocks well elevated so that the intestines will drop out of the pelvis. Then gentle pressure is made upon the protruding mass, beginning immediately adjacent to the cervical ring; in other words, the portion of the uterus which inverted last should be replaced first. After the displacement has been corrected the recumbent position should be maintained with the head at a low level. A somewhat similar procedure is obtained by pressure on fundus with gauze packing, or soft colpeurynters placed against it. We do not recommend the employment of long-continued pressure on the fundus because of the danger of pressure necrosis of the uterine wall. Formerly a repositor of

hard rubber (Aveling) was extensively used, but its employment was so constantly followed by intense pain and frequently by perforation of the uterus that it is now rarely employed.

In the more chronic cases, or where pressure replacement is not effective, conservative operative measures have been devised. These consist of incision of the fibers of the constructing cervical ring so as to relax the tension, following by taxis, until the inversion is reduced. In this type of reduction the peritoneal cavity is not opened.

Dilatation of the constricting ring can be accomplished in some instances by a dilator introduced through an abdominal incision, or the resistance offered by the cervix may be overcome by a dilator passed per vaginam up to the fundus. Finally, complete division of the anterior or posterior uterine wall may be made through a vaginal approach or an abdominal incision with reposition and suture of uterine wall.

The safest and most satisfactory method of replacement in the majority of chronic cases is the vaginal operation with incision of the anterior uterine wall (Spinelli operation) or the posterior uterine wall (Küstner's operation). By these methods the vesico-uterine fold of peritoneum or that of the culdesac respectively are opened, the anterior or posterior uterine wall and cervix are incised which facilitates reduction of the infiltrated sclerotic wall. The wall is then sutured in layers, the uterus is replaced in the abdominal cavity, and the vaginal vault is repaired.

In addition to the above methods, amputation of the fundus or complete vaginal hysterectomy have been employed in cases which could not be treated by more conservative measures.

Anesthesia is necessary to produce relaxation, and recently several reports have appeared in the literature (de Gaudino) emphasizing the advantage of intraspinal anesthesia, which causes such marked tissue relaxation as to permit a very easy reposition even in chronic cases.

Evans, in a recent compilation of 60 cases of inversion, found that 32 cases were reduced by taxis, 7 by repositors, 1 had a spontaneous reduction, and 18 were treated by surgical proced-

ures (11 by hysterectomies or laparotomy and 7 by anterior or posterior hysterotomy).

Mortality.—The mortality of inversion depends upon the severity of the initial symptoms accompanying an acute displacement and also upon the ease with which replacement can be effected. Statistics gathered from the literature give a wide range of mortality—from 14 to 7 per cent. Thorn, analyzing 399 acute inversions, found 64 cases died (16 per cent.)—33 from hemorrhage, 14 shock, 15 sepsis, and 2 lung emboli. In the chronic cases the long-continued bleeding in addition to the chronic sepsis involving the exposed uterine mucosa jeopardizes the woman and makes her a poor risk if surgery is necessary for replacement. In Evan's series of 60 cases there were 11 deaths (18 per cent.), 4 died at once or within twenty-four hours after labor. Within the last few weeks, in a review of 59 inversions reported by Mason and Rucker, there were 9 deaths, all occurring in the acute cases, a mortality rate of 15 per cent. Shock was the most important factor causing death, sepsis playing a relatively less important rôle.

The following case of inversion was treated in our Obstetrical Department at University of California Hospital:

J. L., twenty-three years of age.

Family history unimportant.

Past history: Ordinary childhood diseases. Scarlet fever at eleven years—no sequelæ.

Menstrual history not remarkable. Catamenia was established at age of thirteen years, four days' duration at twenty-eight-day interval. Patient was not married. Her last period began August 28th, labor due June 2d. The pregnancy was entirely uneventful. Physical examination was normal. Wassermann negative. Pelvis showed normal measurements. The patient entered the hospital May 12th, with ruptured membranes, slight vaginal show, and pains coming every five to six minutes.

First stage of labor: Membranes had ruptured at 5 A. M. May 12th; one-half hour later pains began. At 6.15 A. M., when she entered hospital, the cervix was found by rectal examination

to be dilated 5 cm., head engaged in R. O. A. position. Five hours later dilatation was complete.

Second stage: Head slowly descended to perineum and remained stationary at this level until 2 P. M., when low forceps were applied and the child was easily delivered. Despite a median episiotomy, a third degree tear occurred.

Third stage: While waiting for the placenta to separate, the rectal tear and perineum were repaired. One hour after the baby was born the placenta was still attached to the uterine wall; 400 c.c. of sterile normal salt solution was injected into the vessels of the cord without causing separation of the placenta. One-half hour later the placenta was separated and expressed by the Credé maneuver. During this prolonged third stage there had been considerable loss of blood, estimated at 1000 c.c., and the patient was in shock. A liter of Ringer's solution was given by hypodermoclysis.

The child weighed 3350 grams, was 49 cm. long, and was in good condition. The placenta weighed 588 grams, and showed an irregular defect about 3 cm. in diameter on the maternal surface which marked the site of incomplete separation. Because of the poor condition of the patient and the absence of excessive bleeding following the expression of placenta the attendant did not attempt to remove the retained placenta. The patient was given ergotole and pituitrin every four hours following delivery. The lochia was not profuse. Twenty-four hours after delivery a blood-clot was gently squeezed out of the uterus, and by firm pressure on the fundus the retained placenta was delivered. There were no unusual symptoms noted at the time.

The puerperium was not remarkable except that the lochia remained hemorrhagic in character and very slightly increased in amount for fourteen days in which the patient was confined in bed. The highest temperature was 37.7° C. thirty-six hours after delivery, dropped slowly to normal on the seventh day following delivery. Fifteen days after the birth of the child, the patient got up. This was followed by a slight increase of bleeding. Two days later, on attempting to walk, there was considerable vaginal bleeding and the passage of several large

blood-clots. At this time the physician made a vaginal examination and the diagnosis of uterine inversion was made. A consultation confirmed the diagnosis.

Fig. 173.—Sagittal section showing complete inversion of the uterus and cervix and prolapse of the fundus to vaginal outlet. Note the engorgement of the uterus which completely fills the vagina. The difficulty of demarcating the lower cervix from the bladder wall is readily apparent.

Several unsuccessful attempts were made to replace the fundus by manual pressure. A Voorhees bag was placed in the vagina against the fundus, but the cervix had clamped down so firmly that reposition was impossible. Following this manipulation the woman bled freely and hemoglobin dropped to 40 per

cent. (Sahli). The patient was grouped and transfused with 300 c.c. of citrated blood. Twenty-four hours later, and four days after the diagnosis of inversion had been made, the patient was brought to the operating room.

After sterilizing the vagina and uterus with sterile green soap and lysol solution the patient was anesthetized. Under

Fig. 174.—Transverse incision through junction of cervix and bladder which opens peritoneal cavity. The bladder is separated from its attachments and is being elevated. The shaggy, friable lining of the uterus is indicated.

the anesthetic, examination showed that the entire vagina was filled with a reddened shaggy bleeding mass, the uterine mucosa. The fundus and cervix were completely inverted (Fig. 173). The uterus was very soft and bled freely. To avoid injury to the bladder it was necessary to exercise great caution in making

the incision through the cervix. When the vesico-uterine fold of peritoneum was identified, it was incised laterally and the bladder was exposed. It was freed from its attachments to cervix and elevated by a large retractor. The entire anterior wall of the uterus was now incised and the inversion funnel was exposed (Fig. 175). The tubes were markedly edematous, and

Fig. 175.—Incision has been extended to fundus of uterus, which exposes the inversion funnel. The tremendous edema of the tubes is seen.

the uterine wall was very soft and atonic. Correction of the inversion was readily accomplished by making pressure in the manner shown in Fig. 176 and the peritoneal surfaces were approximated. The uterine wall was now sutured in three layers with chromic No. 2 catgut and the peritoneal surfaces were accurately joined. Following this attempts were made to replace the uterus into the abdominal cavity, but the tissue was

so soft and atonic that even though the incision was enlarged laterally beneath the bladder, pressure from below could not force the swollen uterus back into the peritoneal cavity. Although the time consumed up to this stage of the operation was just fifteen minutes, the patient began to run a rapid thready

Fig. 176.—Correction of inversion begun by pressure of fingers and thumbs along cut surface so that peritoneal coat becomes external and the lining of the uterus becomes internal. Sutures are then placed to approximate uterine wall.

pulse (150 per minute) and the need for haste was imperative. Accordingly, a vaginal hysterectomy was quickly and easily performed, and a small drain was inserted beneath the bladder and the vaginal vault was closed. The woman made a smooth convalescence and was discharged from the hospital fourteen days after operation.

Summary.—Inversion of the puerperal uterus is rare and can usually be attributed to errors in obstetric art. It is most likely to occur in the third stage of labor and should always be considered as the etiologic factor of acute shock and hemorrhage after labor. The diagnosis is easily made and, in the absence of shock, immediate manual replacement is usually successful. In the chronic cases the cervix may act as a barrier to manual reposition. Death is due to shock, hemorrhage, or chronic sepsis.

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CLINIC OF DR. ARTHUR L. FISHER

STANFORD UNIVERSITY HOSPITAL

TUBERCULOSIS OF THE SPINE

WE happen to have today 2 cases of spinal tuberculosis—2 cases of different clinical aspects and symptomatically dissimilar.

The one, D. W., a girl fourteen years of age, was brought to the hospital with the history that her legs had become gradually weaker and that at the present time she is unable to walk.

The other, a boy ten years of age, was brought by the father because he noted a gradually increasing deformity of the back. As will be shown shortly, these cases are extremes, but they represent beautifully the diversity of symptoms that may be brought out in tuberculosis of the spine.

You remember in a case shown last week and described as a typical case, certain symptoms and signs were brought out. Briefly recapitulated, these are pain in the back or in the abdomen. Stiffness of the back—occasionally night cries and night-sweats. Disinclination to use the back and lack of desire to play.

On physical examination the most striking thing is the attitude—the back is straight and stiff and there is an appearance of "settling into itself." Added to this there is the kyphosis; always an angular kyphosis, never a rounded one. (I cannot repeat too frequently nor emphasize too much that which I told you last week. There are but three possible causes of an angular kyphosis—viz., tuberculosis of spine, fracture of the spine, particularly crushed fracture of the body, and pyogenic osteomyelitis. This last is in time of peace a rare disease. It is also an acute and serious disease beginning with chill and rigor and

the accompanying high temperature. In case of fracture of the spine there is usually the history of injury, but this may be misleading, as in fracture cases this history may be missing and the usual story in tuberculosis is that the patient met with an injury.) The back is held stiffly and on attempting to bend forward the spine moves as a whole—the muscle spasm being brought out strongly. You remember that when the child was asked to pick up a bunch of keys from the floor, instead of bending over and picking them up as you or I would, he slid down his thighs on his hands, holding his back perfectly rigid. When he was placed upon the table face down and lifted by both legs with the chest on the table the back muscles went into spasm immediately and the back was held rigidly instead of sagging. As I remember it now no psoas spasm was demonstrated in that case. That child was a fairly typical case.

The 2 cases for demonstration today vary from the typical somewhat.

This boy, P. C., aged ten years, has felt perfectly well, and has been going to school and playing with the other boys. The only reason he was brought to the clinic was that a deformity was noted. You observe that he is a rather undernourished boy. There is an apparent disproportion between the length of his arms and legs, on the one hand, and of his thorax on the other. Also you will note that the thorax appears to bulge in front, as though the sternum were forced out. There is a large angular kyphosis with its apex at about the ninth thoracic spine. He can bend forward easily and without any spasm of the back muscles. He picks up my keys in a perfectly natural manner. The knee-jerks and Achilles' jerks are normal and equal on the two sides. There is no ankle-clonus. How, then, do we make a diagnosis of spinal tuberculosis? The angular kyphosis is the one thing that makes us have our suspicions, and these are confirmed by the *x*-ray pictures that I now show you. You see the body of the tenth is destroyed to a very great extent and that the body of the ninth is involved to a lesser extent. The rest of the vertebræ are normal. There is a small paravertebral abscess indicated by this density seen to either side of the spine

in this anterior posterior view and in front of the spine in the lateral.

I stated a moment ago that the apex of the kyphosis was at about the ninth thoracic spine. There are two main landmarks from which to count the spinous processes: A line connecting the crests of the ilia crosses the fourth lumbar vertebra and a line connecting the angles of the scapula crosses the seventh thoracic vertebra. By counting either up or down from these a given spinous process can be determined.

Now the other case—the girl lying in bed: As she lies there in the bed she appears rather stout, well-nourished, and of a rather ruddy complexion. There is a history of backache that goes back over a period of a good many months—just how long it is impossible to determine. The history is inaccurate. You see that when I ask her to move her legs she is unable to do so, though she is making a strong effort, as one can see from looking at her attempts. Now observe the reflexes. The knee-jerks and Achilles' jerks are greatly exaggerated and there is a definite and well-marked ankle-clonus on both sides, more marked on the left. Her skin sensations are normal. She can distinguish heat and cold, the sharp and the head end of a pin perfectly well.

Now we will turn her over. You see at once an angular kyphosis located in the lower part of the back. Counting upward from the line joining the iliac crests we find that the apex of the kyphosis is about at the twelfth thoracic, but that the kyphosis begins lower and ends higher than this. Now on attempting to lift the patient from the bed by raising both legs at the same time you see the spinal muscles go into spasm immediately and the back is lifted without sagging. To bring out psoas spasm this is one maneuver: Raise one leg gently with one hand, keeping the pelvis fixed with the other; then carry out the same manipulation on the opposite side. When there is a psoas spasm or a psoas contracture, the leg on the afflicted side cannot be superextended to the same degree as on the unaffected side. Another method of bringing out psoas spasm which I will not try in this case is to put the patient on the back with the buttocks just at the edge of the table and let

the lower extremities dangle. The side on which there is psoas spasm will be flexed and slightly rotated inward. By pressing gently downward on the knees the tension will be found to be greater on the affected side. The *x*-rays in this case show a destructive lesion in the bodies of the affected vertebræ and a rather large psoas abscess.

A sense of fluctuation can be made out over this mass as it comes down over the psoas muscle.

Here, then, we have a case of tuberculosis of the spine with a paralysis due to pressure on the cord.

It was just such cases as these that were first described by Percivall Pott under the title of "Palsy of the Lower Limbs, which is Frequently Found to Accompany a Curvature of the Spine and is Supposed to be Caused by It."

It is this description that has given the name "Pott's disease" to tuberculosis of the spine. The paralysis is probably never due to bony pressure, but to the pressure of granulations that grow out over and compress the anterior pyramidal tracts.

Next the question arises as to what shall be done for these children. Several forms of treatment have been in vogue; viz., attempted fixation of the spine by means of plaster of Paris —either a jacket or a plaster bed. Second, rest on a Bradford frame. Third, sunlight treatment. Fourth, operative fixation of the spine.

Let me state at the outset that I have a very strong opinion as to the proper treatment of this condition. I am firmly convinced that the operative fixation, the ankylosing operation, has converted an incurable into a curable disease. If later in your medical careers you go elsewhere to study you will hear other opinions. There are many orthopedic surgeons who do not operate upon all cases of spinal tuberculosis. As I have taken such a positive stand I should have some facts on which to base my position. What are these facts? First, from the compilation of a large number of cases it has been found that the average length of life after the inception of the disease is about twelve years; as most of the cases begin in childhood, this means an early death. This is further verified by the fact

that one sees very few adult hunchbacks going about the streets. There are a few, and from the examination of a small number of cases that I have been privileged to see either at operation or postmortem, nature has attempted to do a fixation operation. In these cases there has been a partial fusion of the vertebræ.

A second and more important reason is that as one operates upon the spine one is struck by the respiratory movement that occurs between the vertebræ. No outside fixation can stop this.

I have dwelt on the importance of fixation, absolute fixation, of the vertebræ, because we believe that where motion exists in a joint subject to tuberculosis there the tuberculosis will persist, but that where motion is overcome, then the disease dies out.

This is the reason for operation, and the spine offers a field for operation at all ages, for we do not attack the parts of the spine that limit growth to any extent. The conditions in other joints, the hip, for example, are different. If we operate on the hips of children we stop the growth of the part and produce a terrific deformity, so it is not done, but we do operate upon tuberculous hips in adults. As the spine presents a different set of conditions, we operate upon it as the method of choice in practically all cases. I say practically all cases, as occasionally a young child may be in poor condition, too poor condition to be a good operative risk. Then we put the child on a frame for a while until it is in better general physical condition, but always with the idea that the operation will follow as soon as the child's general condition permits.

There are two types of ankylosing operations. The one is to insert a bone-graft taken from the tibia and insert it into the split spinous processes. The other type is one in which the vertebræ are made to fuse by using bone from the vertebræ themselves. This is done by skeletonizing the bones completely, and completely it must be. All soft parts, including periosteum, must be separated from the bone. After this is done the joints formed by the articular processes are curetted and the adjacent edges of the laminæ are freshened and pieces of bone turned

back so that they may grow together and fuse. This is done on either side. And finally the spinous processes are freshened and cut so that they can be turned back; the fourth on the base of the fifth and the third on the base of the fourth, and so on. Both types of operation have certain advantages and certain disadvantages.

The former type has the advantage of being easier to do and of requiring a much shorter time. Its disadvantages are that the fusion is not as strong and also that the graft not infrequently fails to hold, especially at or near its middle.

The second type operation has the advantage of extremely strong fusion with a somewhat larger percentage of primary successes. Its disadvantages are the greater technical difficulties (which really should not count) and the greater length of time it takes to perform it. However, if done carefully and bloodlessly and if the operator avoids using a mallet and hammering on the spine when attacking the laminæ, shock can practically always be avoided.

I mentioned a moment ago "a larger percentage of primary successes." This would indicate that all cases are not primary successes. This is so. There are several causes for failure of the operation. In both types of operation there are two causes for failure:

In the first type—not carrying the graft high or low enough, and, second, the failure of the graft to take, either as a whole or in part.

In the second type of operation the failures are due to not carrying the operation either high or low enough, and the failure of fusion at any part of the field.

Generally speaking, the field of operation should extend at least two vertebræ above and two below the site of the lesion.

In a certain proportion of the cases a second operation is necessary on account of any one of the above causes. These secondary operations are usually more easily carried out than the first operations.

There is one complication of spinal tuberculosis that is extremely serious, and that is a psoas abscess that communicates

with the outside world or, in other words, a secondary infected psoas abscess. Remember this: A psoas abscess should never be opened and drained as a pyogenic abscess is. This would ultimately mean the death of the patient, as when secondarily infected it will never heal, and the patient will die either of a pyogenic infection or of amyloid disease.

Every effort must be made to keep a psoas abscess from rupturing through the skin. When, as frequently happens, it seems probable that abscess is advancing rapidly it should be aspirated under the strictest aseptic precautions, and the aspiration wound protected so that it will close.

Unruptured abscesses, even of huge size, will usually be absorbed.

The prognosis in tuberculosis of the spine treated by operation is good. The disease dies out and the patient gets well. The deformity usually remains, though it is practically always less than before operation.

If tuberculosis of the spine exists as a part of a multiple tuberculosis the question of recovery depends not so much on the condition of the spine as of the other organs involved.

Even in cases with paraplegia, as in this girl, the outlook is favorable. We look forward to seeing her regain the use of her lower limbs as well as getting rid of the disease in the spine.

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NECK DISSECTIONS

I. INTRODUCTION

OBSERVATIONS of the too frequent indifferent methods and the correspondingly poor results obtained in neck dissections in general invite an attempt to develop an orderly and clear-cut technic and a definite understanding of the objects to be attained. The substance of this paper recalls the teaching of the surgical masters past and present, and, in addition, records the experiences of the authors extending throughout a decade of surgery of the neck.

II. CLINICAL INDICATIONS

Neck dissections are performed for metastatic carcinomata, primary endotheliomata, localized Hodgkin's disease, intractable tuberculosis, and for less frequent conditions, such as lymphosarcoma, carcinoma of the branchial cleft, and tumors of the carotid body. The purpose of the present paper is to outline a method for the eradication of malignancy which is primary elsewhere and which is metastatic in the neck. Primary carcinoma of the lower lip or of the skin of the face below the mouth metastasizes to the glands immediately inferior to the mandible, while carcinoma of the cheek, tongue, tonsil, pharynx, antrum, and the lateral portions of the face metastasize primarily to the lateral regions of the neck. Accordingly, from the surgical metastatic standpoint, the neck is divided into two metastatical regions, *i. e.*, the suprahyoid region for carcinoma about the lip and the lateral region of the neck for the other growths enumerated.

III. ANATOMIC CONSIDERATIONS

The structures of the neck are so complex and the surgical procedure is so fraught with dangers in the hands of the uninformed that a thorough anatomic understanding of the neck is of first importance.

A. **Suprahyoid Region of the Neck.**—The suprahyoid region, or, in general, that region between the mandible or lower jaw and the hyoid bone, is divisible into three compartments—a submental compartment and two submaxillary compartments.

The submental division of the suprahyoid region is a triangle bounded laterally by the anterior bellies of the digastric muscles and inferiorly by the hyoid bone. The apex of this isosceles triangle is at the symphysis of the mandible. The anterior wall or covering of the submental compartment is made up of the skin and the platysma muscle as well as a sheet of enveloping or deep fascia of the neck. Its posterior wall or floor is composed of the anterior portions of both mylohyoid muscles. The contents of this compartment are simply loose areolar tissue containing lymph-glands with no important nerves or blood-vessels.

Each submaxillary region is also a triangle bounded laterally and below by the two bellies of the digastric muscle, and above by the horizontal ramus of the mandible prolonged to the parotid gland. It is covered by the skin and platysma, deep to which is attached a thin layer of enveloping aponeurosis continuous with that over the submental triangle. The floor or back wall is composed of the lateral portions of the mylohyoid muscle, and the underlying hyoglossus muscle projected laterally to the anterior border of the sternocleidomastoid muscle and the parotid gland.

The contents of the compartment are more important than those of the submental triangle. Each contains a submaxillary salivary gland, the facial vessels, a quantity of loose areolar tissue in which are embedded several lymph-glands, and the more vital structures, viz., the hypoglossal and the lingual nerves. The facial vessels traverse the compartment in its lateral half and cross over the horizontal ramus of the mandible at a point approximately midway between angle and symphysis. The hypoglossal nerve crosses the compartment near its inferior

angle where the digastric bellies attach themselves to the hyoid bone. It lies deep to the mylohyoid muscle, and its further course over the hyoglossus is in the cleft between the two muscles.

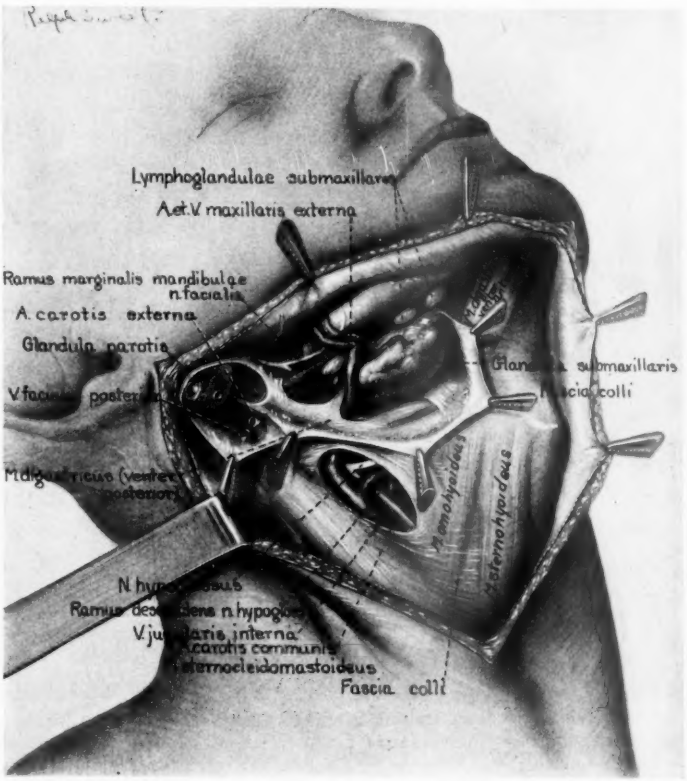

Fig. 177.—Dissection to show the submaxillary compartment. The skin-platysma flaps expose the enveloping fascia of the neck which has been partly removed to show the contents of the compartment and its investment of the parotid gland together with its relation to the great vessels.

The lingual nerve lies hidden by the ramus of the jaw and courses along and in the sulcus between the under surface of the mandible and the hyoglossus floor. Perhaps the largest branch leaves the

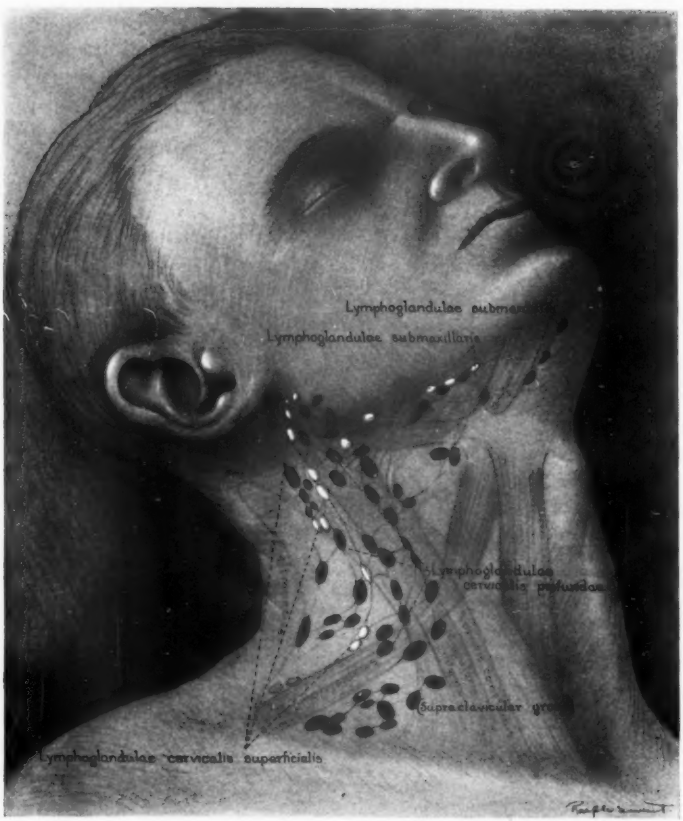

Fig. 178.—Schematic drawing to represent the distribution of the lymphatic gland chains of the neck and their relationship to one another and the neighboring structures. The deeper glands of the cervical chain are the ones primarily involved in carcinoma of the tongue. Note the close relationship between these glands and the internal jugular vein. Note the highest glands lying against the vein at the base of the skull and embedded in the lower pole of the parotid gland. Note the lowest gland at the lower edge of the omohyoid muscle as it crosses the vein. Note the barren zone between this group and the suprahyoid chains. Note this break between the deep cervical glands and the supraclavicular chains. The suprahyoid chains are primarily involved in carcinoma of the lip. The glands first affected are usually those lying against the ramus of the jaw along the edge of the submaxillary salivary gland and those at the apex of the submental triangle just beneath the point of the chin.

nerve at the posterior margin of the mylohyoid and enters immediately the substance of the submaxillary gland.

Two important near-related structures which do not actually lie within the compartment are the marginal mandibular branch of the facial nerve and the inferior pole of the parotid salivary gland. The marginal mandibular nerve courses along the outer surface of the mandible, deep to the platysma, but superficial to the enveloping fascia. The inferior pole of the parotid gland is separated from the true compartment by only a thin fascia and is thoroughly exposed in both anatomic and clinical dissections.

B. **Lateral Region of the Neck.**—Under the heading of the lateral region of the neck we include all the structures between the trapezius muscle laterally and the ribbon muscles of the thyroid gland mesially, the clavicle inferiorly, and the posterior belly of the digastric muscle with the base of the skull superiorly. This region so described includes, therefore, the rest of the neck, omitting only those structures which are strictly infrahyoid, *i. e.*, the thyroid gland, the laryngotracheal tube, and the esophagus.

The roof or outer covering of this general region is made up of the skin-platysma layer and the enveloping layer of the deep fascia of the neck. The posterior wall or floor is the prevertebral fascia covering the deep muscles of the neck. This space is naturally divided into subcompartments, *i. e.*, a region overlaid by the sternocleidomastoid muscle, the sternocleidomastoid or carotid region, and the region posterior to it, the posterior cervical triangle.

(*a*) *The Carotid or Sternocleidomastoid Region.*—This region is an elongated quadrilateral space, bounded by the borders of the sternocleidomastoid muscle, by the mastoid process, and clavicle. In depth it is considered to extend to the prevertebral fascia.

The sternocleidomastoid muscle, invested by the splitting of the before-mentioned enveloping fascia which helps form the roof of the entire neck, may be said to overlie the region at hand. In consideration of this muscle it should be here noted that the spinal accessory nerve enters and leaves it in its superior third. Deep to this roof muscle is the omohyoid muscle, an

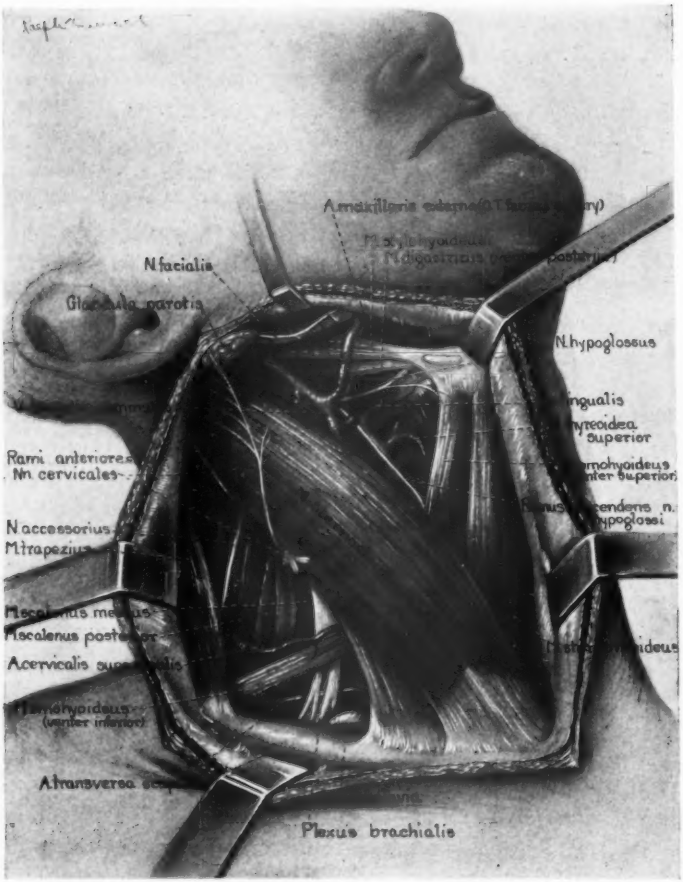

Fig. 179.—The lateral region of the neck. The skin-platysma flaps are turned back and the enveloping fascia colli is removed. Drawing is designed to show the sternocleidomastoid or carotid and the posterior cervical divisions of the lateral neck with the sternocleidomastoid *in situ*. Attention is called to the highly vascular superior extremity of the carotid region.

important landmark. The pretracheal fascia or the anterior prolongation of the enveloping aponeurosis of the neck forms here a more or less distinct layer, it being somewhat cellular and

areolar above the omohyoid muscle and resistant to a greater degree including and inferior to it. Its importance lies in the

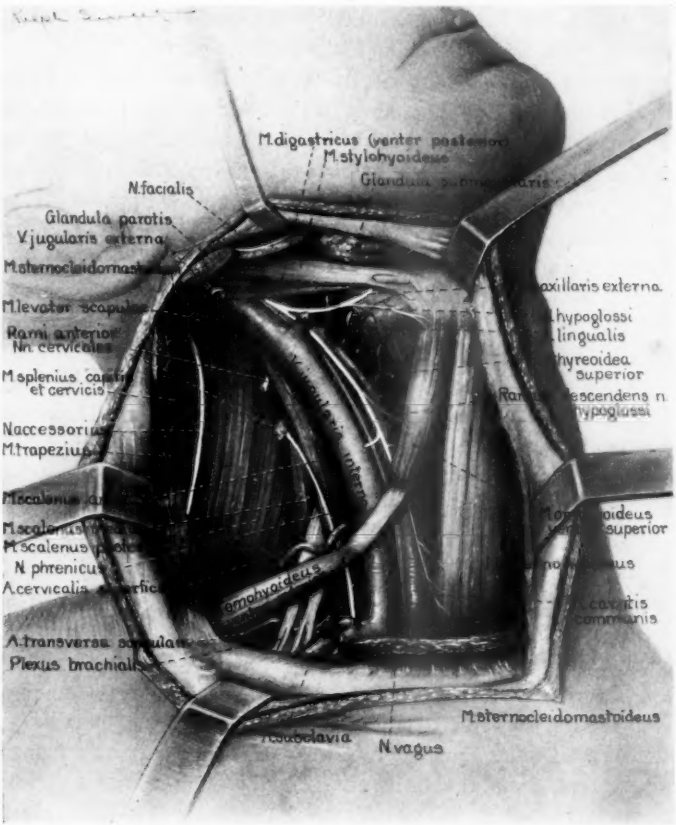

Fig. 180.—The lateral region of the neck. The sternocleidomastoid muscle is removed to show the structures deep to it and the continuity of the carotid and posterior cervical divisions of the region.

fact that it furnishes a fibrous expansion from the clavicle to the hyoid bone which acts more or less as a protection to the great vessels.

The contents of this retromuscular compartment include chains of lymph-glands embedded in areolar tissue, the great vessels of the neck and the vagus nerve enclosed within the carotid sheath, the thyrolingual-facial veins, the hypoglossal nerve, and on the left side of the neck the thoracic duct.

The lymph-glands are largely those of the superior deep cervical chain, and they lie mainly in the loose areolar tissue about the vessels in the upper two-thirds of the region. A few glands of this chain extend a little below the junction of the two bellies of the omohyoid muscle, and a few supraclavicular glands of the subclavian or inferior deep cervical chain lie along the upper margin of the clavicle. There is continuity between the superior deep cervical chain of glands and the submaxillary glands superiorly and with the inferior deep cervical or supraclavicular glands inferiorly.

The contents of the carotid sheath are the common carotid artery, the internal jugular vein, and the vagus nerve. The common carotid artery runs from below upward under cover of the mesial border of the sternocleidomastoid muscle as far as the upper margin of the thyroid cartilage where it bifurcates into its internal and external branches. Over the course of the common carotid artery the internal jugular vein lies external to it. Superior to its bifurcation, however, the internal carotid artery runs posterior to the internal jugular vein in its course to the base of the skull. There are no branches to the internal or the common carotid artery in the neck, while the external carotid in our region gives off the superior thyroid, lingual, and external maxillary branches. The superior thyroid artery leaves the parent trunk about 1 cm. from the bifurcation, and the lingual and facial vessels at a more distant point.

The internal jugular vein begins at the base of the skull deep and anterior to the mastoid process of the temporal bone and deep to the external auditory meatus. It passes downward and forward beneath the sternocleidomastoid muscle and lateral to the common carotid artery.

The vagus nerve leaves the skull beside the internal jugular vein and courses mesial to this vein to the common carotid artery,

where it lies between and behind these structures in the carotid sheath until its entrance into the mediastinum.

The hypoglossal nerve emerges from the base of the skull near the two before-mentioned structures and courses with them for a short distance to a point on a level with the hyoid bone, so that it runs forward and upward and crosses between the posterior belly of the digastric muscle and the hypoglossus muscle to the submaxillary compartment, as has been already described. The spinal accessory nerve leaves the skull soon to traverse the superior third of the sternocleidomastoid muscle and to be distributed through the posterior compartment to the trapezius muscle.

The veins from the face, the tongue, and the thyroid gland enter into a more or less common trunk, the thyrolingual-facial trunk, which lies in the superior portion of the region and communicates with the internal and external jugular vein.

The anterior branches of the cervical plexus with the exception of the phrenic nerve pierce the prevertebral fascia to emerge through the posterior triangle at about the posterior margin of the sternocleidomastoid muscle. These are the great auricular and the lesser occipital nerves and, in general, the nerves that supply the scapula. The phrenic nerve lies on the anterior scalene muscle deep to the prevertebral fascia or the floor of the region.

The parotid gland, while encased in a compartment of its own is, nevertheless, in intimate relation not only with the submaxillary region, but with the superior portion of the sternocleidomastoid region. Its importance in this discussion lies in the fact that some of the lymph-glands of the superior deep cervical chain are in close contact with its inferior pole.

Within the region on the left side the thoracic duct enters this compartment from the chest and empties into the junction of the left subclavian and the left internal jugular vein. The cords of the brachial plexus can be seen beneath the floor of the region through the transparent prevertebral fascia and do not in any way belong in this space.

(*b*) *The Posterior Compartment or the Posterior Cervical Triangle.*—The posterior compartment is a triangle bounded posteriorly by the trapezius muscle, anteriorly by the sternocleidomastoid muscle, and inferiorly by the clavicle. Its floor or posterior wall is made up of the prevertebral fascia, a continuation of the floor of the sternocleidomastoid region. The areolar lymph-gland-bearing tissue, which, for the most part, makes up the contents of this compartment comprises glands of the superior deep cervical chain as well as inferior deep cervical systems draining the axilla and mediastinum. The glands of these two deep cervical chains are separated by the posterior belly of the omohyoid muscle. The only important other structure in that area of the compartment superior to the omohyoid muscle is the spinal accessory nerve. This nerve runs a variable course from the posterior edge of the sternocleidomastoid muscle to the anterior border of the trapezius. The important structures in the area inferior to the omohyoid muscles are the subclavian artery and vein and several large branches of the acromiothoracic trunk. Other vitally important structures of the neck are not occupants of this compartment, *i. e.*, the cords of the brachial plexus as they emerge from the interval between the scalenus anticus and the scalenus medius muscle, the phrenic nerve, the inferior thyroid artery, and the sympathetic chain, for these structures lie deep to the prevertebral fascia and, therefore, beneath the floor of the region.

IV. THE SURGICAL DISSECTION OF THE SUPRAHYOID REGION

Indication.—The suprahyoid dissection, independent of the lateral neck dissection, is used practically exclusively for metastatic carcinoma of the lip, and then only where gross examination of the submental and submaxillary glands, after removal, shows no evidence of metastases. A complete or a combined neck dissection would be called for when there is gross involvement of the submaxillary or submental groups. This follows from the general rule regarding metastatic carcinoma that secondary chains must be removed where there is gross involve-

ment of the primary chains. Seldom, however, does carcinoma of the lip require more than the simple operation.

The uncombined or the pure suprahyoid neck dissection is often a bilateral affair because usually the lesion of the lip crosses the midline or is near the midline. The bilateral dissection adds very little to the operation and it gives the patient a symmetric neck. This procedure should follow the resection of the local primary lesion as soon as convenient, and always within a few weeks, providing the microscopic study of the primary lesion shows muscle involvement by the infiltrating growth.

Method of Procedure.—A cut-throat incision is employed (Fig. 181), extending from mastoid process to mastoid process, and passing across the front portion of the throat just above the hyoid bone. This incision is modified if a unilateral suprahyoid dissection only is contemplated, and then extends from the mastoid process only a short distance across the midline to the anterior belly of the opposite digastricus at its insertion on the cornu of the hyoid bone.

The superior flap is dissected up, taking platysma with skin and subcutaneous tissue, while the inferior flap is undisturbed. The upper flap is turned back to the insertion of the platysma or until the lower portion of the outer surface of the mandible is exposed. This lays bare the contents of the triangles to be dissected covered by the enveloping fascia. With a sharp blade this fascia is divided all along the anterior border of the mandible and over the parotid gland from chin to sternocleidomastoid muscle. By a "wiping down" process or blunt dissection the separation of the glandular and areolar contents from the periosteum of the bone, from the parotid gland, and from the outer surface of the mylohyoid and hyoglossus muscles is accomplished. This cleaning-out process is early held up by the facial vessels, which must be ligated and cut where they pass over the ramus of the jaw (Fig. 182). At this point one proceeds with caution until the marginal branch of the mandibular nerve (seventh) is isolated and retracted out of danger. This nerve can best be located and traced out by picking it up as it comes across the ramus of the jaw together with the facial vessels.

The destruction of this nerve means a permanent paralysis of the lower angle of the mouth. The "wiping down" process may now continue with the cleaning off of the outer surfaces of the mylohyoid and hyoglossus muscle. It is again halted by the

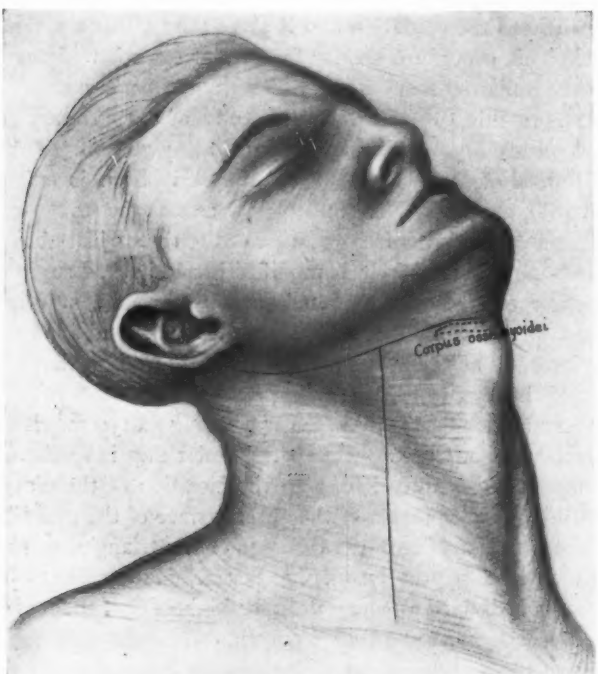

Fig. 181.—Incisions employed for neck dissections. Horizontal line represents incision for suprahyoid unilateral dissection. It extends from mastoid to the anterior belly of digastricus of opposite side. It lies in the natural folds of the neck and passes just above the hyoid bone. The upper flap only is lifted. The vertical line represents the incision for the lateral dissection. It extends from the middle of the horizontal incision.

submaxillary branch of the lingual nerve, by the submaxillary duct, and by the plexus of veins about the duct. The submaxillary branch of the lingual nerve enters the superior pole of the salivary gland, and, accordingly, traction downward of this

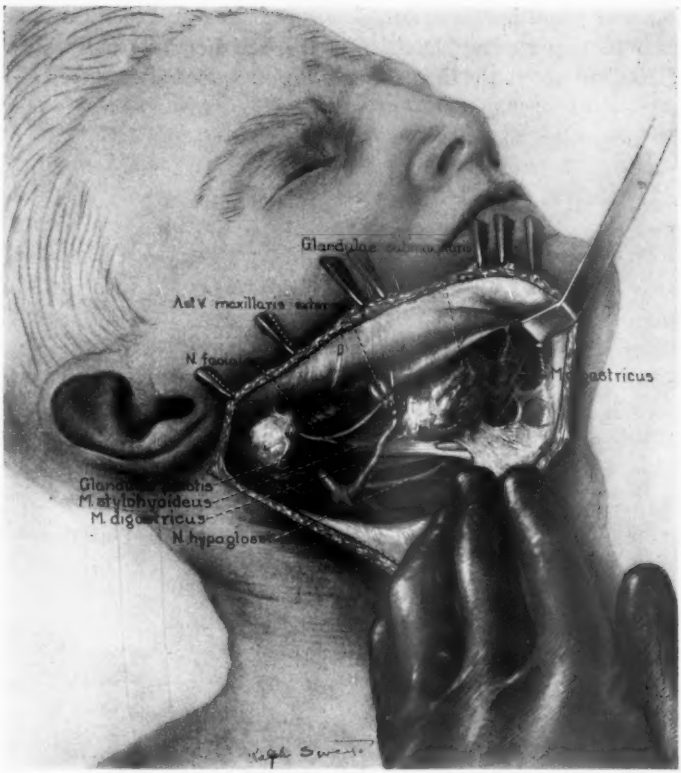

Fig. 182.—Early stage suprahyoid dissection. The facial vessels have been divided, the marginal branch of the mandibular (seventh) has been isolated and preserved; the lower pole of the parotid gland has been cleaned off and is still intact. The submaxillary salivary gland has been freed from the ramus of the jaw by the sharp division of the cervical fascia. The drawing is not a true representation of the actual dissection in that the submental triangle is not shown and the lower flap has been lifted to show structures below the posterior digastric belly. The submental triangle is dissected in all neck dissections, while the lower flap in the suprahyoid dissection is never lifted.

gland, along with the areolar and lymph glandular contents of the triangle pulls the lingual nerve into view (Fig. 183). The point of entrance of this nerve branch into the upper pole of the

salivary gland is at the lateral border of the mylohyoid muscle near its upper edge. Division of this salivary branch frees the gland and allows the lingual nerve to retract out of danger. The

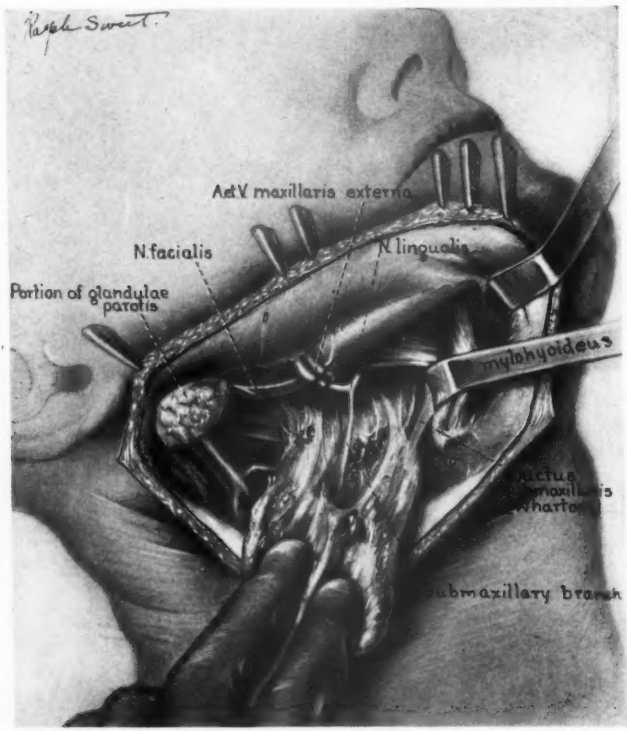

Fig. 183.—A late stage in the suprahyoid dissection. The lingual nerve has been pulled down into view. It will retract out of danger when the branch to the submaxillary salivary gland has been divided. Wharton's duct is about ready for ligature and division. The hypoglossal nerve crosses the angle made by the two bellies of the digastricus muscles just beneath the duct on the hyoglossal floor.

salivary duct is exposed where it enters the base of the tongue by strong traction medialward on the lateral edge of the mylohyoid muscle. Ligations and divisions of the duct and veins

release the last hold on the triangle contents. Again caution needs to be observed because the hyoglossus nerve traverses the triangle near the salivary duct and sometimes in the midst of the mass of veins. Before ligation of these veins in this angle, therefore, the nerve should be identified and pushed aside. The dissection is now completed by the final clearing off of the mylohyoid and the hyoglossus muscles down to the posterior belly of the digastricus and the styloid muscle and the central ligation of the facial vessels. The facial vein crosses over the digastricus muscle, while the artery comes up from beneath that muscle.

The tissues removed should include the submaxillary salivary gland, the facial vessels where they cross the space, and all the lymph-glands and loose areolar tissue. The contents of the submental region, while removed separate from those of the submaxillary compartment, are, in reality, continuous with those of the submaxillary and lie on a common floor. The anterior belly of the digastricus muscle, therefore, must be lifted so as to clean thoroughly the mylohyoid floor. The parotid gland is not disturbed in this dissection.

V. THE LATERAL NECK DISSECTION

Indications.—The lateral neck dissection is sometimes carried out as described below, but usually is combined with and follows the suprahyoid dissection. The combined suprahyoid and lateral operation is performed for metastatic carcinoma of the buccal cavity, for primary carcinoma of the branchial cleft with or without metastases, for primary endothelioma arising in the lymph-glands of the neck, and occasionally with modifications for severe tuberculosis. It is carried out without modifications in all instances of metastatic carcinoma and must be done in all instances of primary carcinoma within the buccal cavity, with the possible exception of occasional instances of very early and strictly localized carcinoma of the cheek or of the gums. This holds true regardless of the size of the lesion or the extent of the infiltration. The neck dissection may precede or follow, or may be combined with the operation on the local lesion. It usually should precede, so as to block off the local area to be treated.

Method of Procedure.—The incision for the combined suprahyoid and lateral dissection is T shaped, the horizontal incision being simply that described above for the unilateral suprahyoid dissection (Fig. 181). The vertical incision is dropped from the midpoint of this horizontal line and strikes the clavicle near the lateral edge of the sternocleidomastoid muscle. This same incision is employed when there is strictly the lateral dissection alone to be made.

The two lateral flaps consisting of skin, fat, and platysma are turned back, the posterior as far as the anterior edge of the trapezius muscle, and the anterior so as to expose the ribbon muscle of the thyroid (Fig. 184). The area to be cleaned out is then outlined posteriorly by the incision of the enveloping fascia at the anterior edge of the trapezius muscle, and the cleaning away of the areolar tissue in this plane down to the prevertebral fascia covering the floor of the neck. This exposes the spinal accessory nerve and divides many branches of the cervical plexus. The area is further outlined medially by the division of the enveloping and pretrachial fascia just lateral to the ribbon muscles of the thyroid, with the consequent exposure of the common carotid artery (Fig. 184). The inferior limits of the area to be dissected are worked out as follows: The sternocleidomastoid muscle is cut transversely about 5 cm. above the clavicle, or approximately at the level of the crossing of the omohyoid muscle. The clavicular stump of this muscle is cleaned off on its under surface and turned back down over the clavicle. It is used later to fill the dead space in the supraclavicular fossa. By blunt and sharp dissection, the supraclavicular tissue is now divided along a straight line paralleling and about 3 cm. above the clavicle or at a level approximately 2 cm. below the omohyoid where it crosses the deep vessels. This line must be below the omohyoid in order to include the whole of the deep cervical chain of lymph-glands because the lowest gland in this chain lies just below the omohyoid muscle over the lateral wall of the internal jugular vein (Fig. 178). It need not be placed lower than this line because the glands about the subclavian vein need not be removed except where the lowest deep cervical gland is

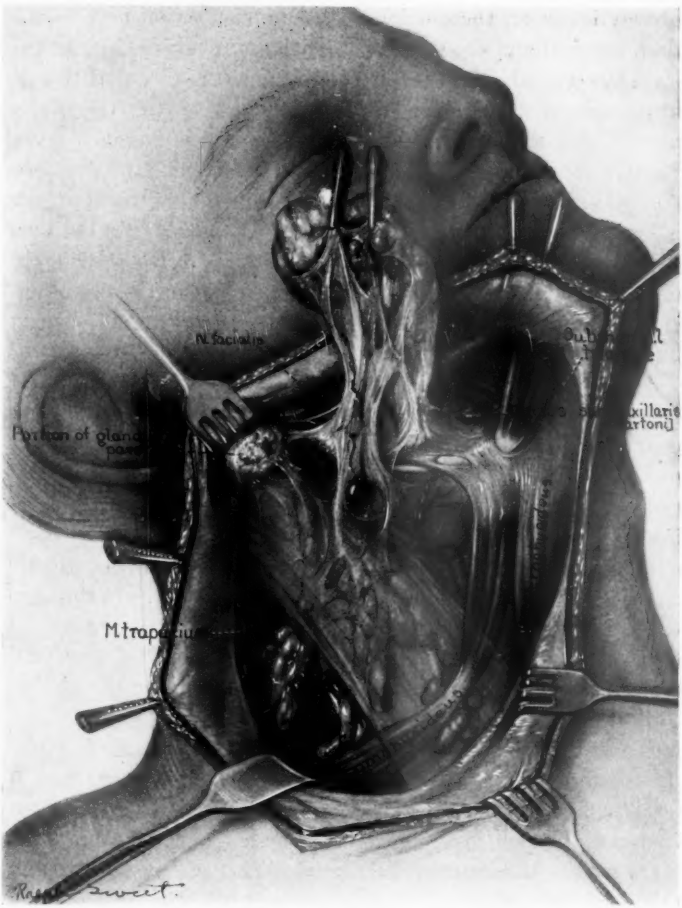

Fig. 184.—Early stage of the complete neck dissection. The suprahyoid dissection has been completed down to the upper margin of the posterior belly to the upper margin of the posterior belly of the digastricus. The flaps of the lateral neck dissections have been laid back. The edge of the trapezius marks the lateral limits and the thyroid muscles mark the medial limits of the area to be dissected. The lower limits are defined by dividing the omohyoid and sternocleidomastoid just beyond the lowest groups of glands in the cervical group.

grossly involved, there being almost no connection between the deep cervical and the subclavian chains of glands. Also at this level the operation is more simple, owing to the fact that there is no danger of wounding the subclavian vessels. As the tissues are divided the first important structure seen is the external jugular vein, which is ligated and divided at the lateral corner. Almost at the same level at the medial angle the internal jugular is exposed. This vessel is also picked up, doubly ligated, and divided. The dissection is now carried down to the floor of the neck, that is, to the prevertebral fascia overlying the deep muscles. Many vessels must be ligated and some nerves may be cut, but no structures of any importance are encountered.

With the accomplishment of this inferior delimitation the isolation of the contents of the lateral neck is now complete except at the deep superior extremity, and the actual removal may now be commenced. The dissection should start from below and proceed upward, following the floor of the neck, that is, following the outer surface of the prevertebral fascia. This process is one of the turning upward of the areolar gland-bearing tissues and with them the internal jugular vein (Fig. 185). In this step the common carotid artery, the vagus nerve, and the prevertebral fascia are thoroughly cleaned of loose areolar tissue. The upward dissection may be carried out without fear of mishap or danger to any important structures because the vagus nerve and common carotid artery are always plainly visible, and the brachial plexus and phrenic nerve are protected by the prevertebral fascia, which is never disturbed. This fascia is identified as a transparent tough covering closely adherent to the deep muscles of the neck. All branches of the cervical plexus come out through this fascia except the phrenic nerve, and all, with this one exception, are divided at their point of emergence through the fascia. No branches of the carotid artery will be seen until the bifurcation which takes place at about the level of the most prominent part of the "Adam's apple." Usually the first indication that the point of bifurcation has been reached is a finding of a branch, the superior thyroid, apparently coming off from the common carotid vessel. This is due to the fact that the

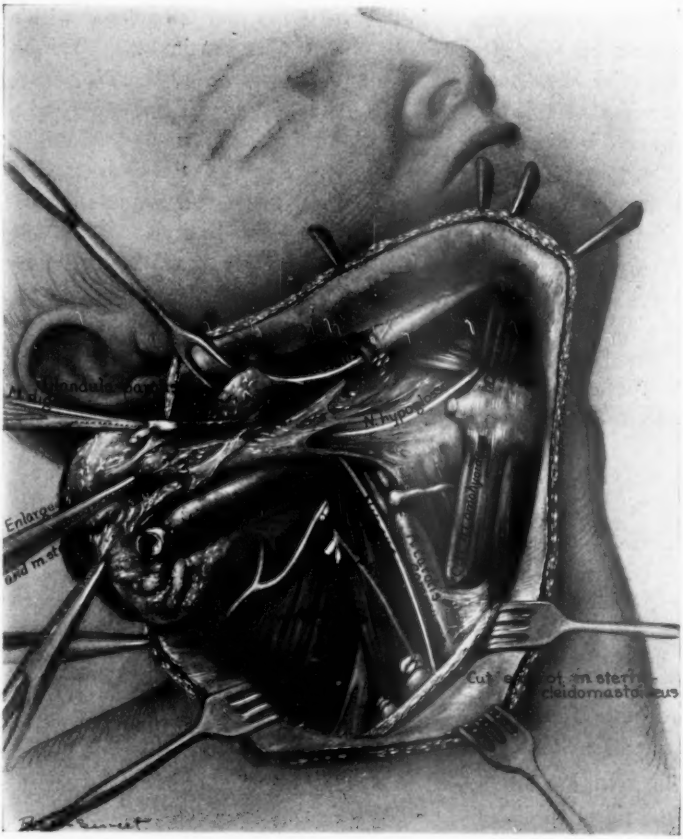

Fig. 185.—Later stage of complete neck dissection. The area to be dissected has been outlined below by the division of the sternomastoid and omohyoid muscles, the ligature and division of the internal jugular vein, and the separation of the areolar tissues down to the prevertebral fascia or floor of the neck. The divided structures have been turned upward in the process of clearing off the floor; the carotid artery and vagus nerve have been stripped of all loose tissue, the branches of the cervical plexus except the phrenic have been cut as they emerge through the prevertebral fascia. The phrenic nerve lies unharmed behind the protecting layer of prevertebral fascia. The posterior belly of the digastricus muscle is shown removed and retracted for sake of clearness. It is usually thoroughly cleaned and retracted without division. It is only taken when involved in a carcinomatous mass.

internal carotid lies behind the external and is enclosed within a common sheath with it for one or more centimeters. The bifurcation can always be demonstrated, however, as taking place proximal to this branch. As soon as the identification is clear a ligature is slipped about the external carotid artery proximal to the superior thyroid, and tied just proximal to this branch, thus insuring the ligature from slipping. Both vessels are then divided after clamping or ligating the distal stumps. With the ligation of the artery the upward dissection exposes the tendinous portion of the stylohyoid and digastricus muscles as they insert on the hyoid bone. Here care must be taken to isolate the hypoglossal nerve which makes a loop below the level of the posterior belly of the digastricus muscles, extending frequently 2 cm. below the lower border at the central portion of the belly and crossing under the muscle in its tendinous portion at the hyoid cornu (Fig. 185). The nerve is easily identified rather deep on the floor of the neck if sought for beneath the hyoid cornu. Dissection may now continue upward and lateralward following along the stylohyoid muscle in the direction of the styloid process, and is usually carried through to the base of the skull. Frequently, however, it is not possible to proceed further than the isolation of the hypoglossal nerve because of metastatic masses which prevent the proper turning up of the neck contents and the complete exposure of the deeper tissues at the base of the skull. Working in this corner without sufficient room may result in the nicking of the internal jugular vein on its under surface with an obscuring and discoloring of the tissue from flooding of the field with venous blood.

The last step takes place at the upper lateral angle, and has to do with the cutting away of the sternocleidomastoid muscle from the mastoid process, with the taking away of the lower pole of the parotid gland and the ligation of the internal jugular vein at the skull (Fig. 186). Approximately the lower 1 to 2 cm. of the parotid gland must be taken because some of the gland at the upper end of the deep cervical chain lies embedded within this structure. In cutting through the parotid, innumerable veins, many of considerable size, must be divided, and progress here

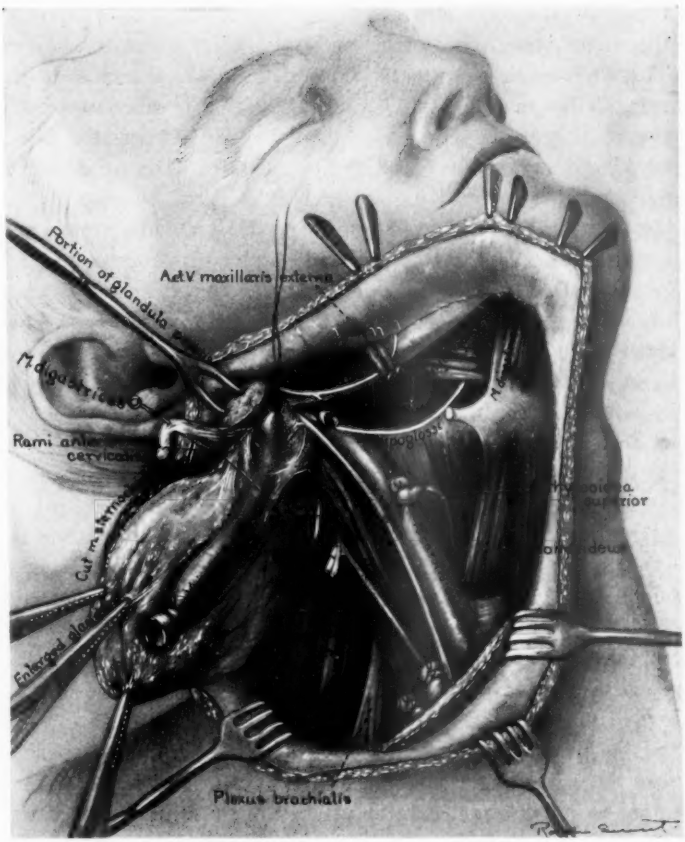

Fig. 186.—Last stages of complete neck dissection. The external carotid artery has been doubly ligated and divided. The hypoglossus nerve has been stripped and carefully preserved. The lower pole of the parotid gland has been taken away and the jugular vein has been ligated at the base of the skull. This cannot be accurately shown because the point of ligation would be too high up under the *parotid* and *angle of the jaw* to be visible from this angle. The vagus, hypoglossal, and accessory nerves lie very close to the vein at the part of ligature and must be identified before the ligature is placed.

usually is slow. Upon completing this dissection the most difficult task still remains, *i. e.*, the isolation and ligature of the in-

ternal jugular vein and the identification and preservation of the vagus, the hypoglossal, and the spinal accessory nerves. These nerves lie close to the floor of the neck, also close to the vein, so that mass ligature is not possible. It is well to approach the vein from one side and then the other, leaving the direct working down on the vessel as the last step. The complete removal of the internal jugular vein is required because of two facts, viz., the intimate relationship of the lymphatic vessels and glands with the sheath of the vein all along its course, and the location of the highest gland in the deep cervical chain against the vein at the skull (Fig. 178). The spinal accessory nerve too often must be sacrificed in the radical dissection for carcinoma because in its passage through the sternocleidomastoid muscle it frequently becomes involved in the tumor mass and cannot be separated without danger of leaving carcinomatous tissue behind.

With the completion of the dissection the floor of the neck is clear; that is, the prevertebral fascia has been cleaned of all loose areolar tissue and is everywhere intact. The vagus, hypoglossal, and frequently the spinal accessory cranial nerves may be seen lying on the floor of the neck, the vagus passing along the lateral border of the common carotid artery, the hypoglossal looping down beneath the belly of the posterior belly of the digastricus muscle and disappearing underneath its end at the hyoid bone, and the spinal accessory passing obliquely downward and backward to disappear beneath the edge of the trapezius near the lower angle of the wound at the lateral corner. The common and internal carotid arteries are also seen traversing the floor of the neck from the clavicle to the base of the skull. A row of stumps of branches of the cervical plexus penetrating the prevertebral fascia, that is, the floor of the neck, lie just lateral to the artery. The phrenic nerve may be seen coming out from behind the lateral edge of the scalenus anticus along with the lowest nerve stumps, but instead of piercing the fascia it courses down along the anterior surface of the muscle belly beneath the prevertebral fascia and disappears behind the clavicle into the chest. The brachial plexus also is seen beneath the same fascia at the extreme lower and medial angle alongside and lateral to the common carotid artery. The remaining mass of loose areolar

tissue surrounding the subclavian vein and covering the apex of the lung pumps up and down with respiration.

VI. DISCUSSION

Modifications of the combined suprahyoid and lateral neck dissection may be allowed in tuberculosis and Hodgkin's disease. In such cases the sternomastoid muscle may be preserved, the cervical nerves are spared, and the internal jugular vein is taken only as a matter of convenience. In metastatic carcinoma, in carcinoma of the branchial cleft, and in endothelioma of the neck never less is done than is outlined above in the description of the combined operation. Sometimes additional structures must be taken, as, for instance, the hypoglossal nerve, and the digastricus and stylohyoid muscles frequently have to be removed because of their involvement within a large carcinomatous mass. Even the vagus nerve sometimes must be removed, especially in endothelioma. Taking less than the whole of the deep cervical chain in metastatic carcinoma involving these groups of glands is just as inadequate as a simple amputation without axillary dissection for carcinoma of the breast.

Simple suprahyoid dissection is an absolute safeguard in cancer of the lip. It should be employed early in the course of the disease before gross involvement of the gland has taken place, and should not be delayed until there is little doubt regarding the malignant nature of the swelling or enlargement of the glands beneath the chin. Microscopic examination of the glands may fail to reveal metastatic carcinoma in a surprising number of instances, but statistical studies show that a high percentage of the cases which are not given the benefit of the neck dissection return later on account of metastases. This is especially true of the cases which show muscle involvement or which have a very slight degree of differentiation of cells. The suprahyoid neck dissection is not mutilating, no vital structures are in danger, the procedure is simple and can be accomplished by one with a limited surgical experience, and the results, as far as protection are concerned, are absolute.

The combined suprahyoid and lateral dissection for metastatic carcinoma in the deep cervical chains is almost equally as satis-

factory even in the presence of gross involvement of these glands, and in the majority of instances gives a complete and permanent block to the spread of the disease by metastases. While it is true that cures are relatively few in carcinoma of the tongue or pharynx, it is the inability to get rid of the primary focus and the infiltration of the floor of the mouth or pharynx and not the inability to control metastases that accounts for the failure. The lateral dissection, while not as simple as the suprahyoid, can be easily mastered, and is not a formidable procedure in the hands of surgeons who are skilled in handling tissues even though they have had little experience in operations upon the neck. Mutilation even in this extensive procedure is negligible. The bilateral combined operation is seldom done, but may be performed without fear of serious consequences. It is wise to allow sufficient time between the two operations for the establishment of collateral circulation.

Apropos of the recent discussions concerning the anesthesia to be employed in complete neck dissection, it has been the experience of the authors that the most satisfactory anesthetic is light ether, that is, a minimum of ether and a maximum of air. Local anesthesia with novocain, nitrous oxid and oxygen, ether, and chloroform have been employed. Ether is preferred because postoperative pneumonia and mortality have been negligible and because the patients have been more comfortable under this type of a general anesthesia. With local anesthesia the discomfort of lying on the table throughout the long period required for a painstaking operation of this sort is a point to be weighed. Under nitrous oxid there is more oozing because of the unavoidable cyanosis, be it ever so slight, and, in addition, the method of administration is more difficult because of the proximity of the operative field to the face.

Obstetric chloroform would be the ideal anesthetic in the hands of an anesthetist absolutely familiar with the drug. Ether should be administered intrapharyngeally with some machine adapted to furnish air under positive pressure. The intratracheal method of ether anesthesia is to be avoided because of its high mortality, the difficulties of administration, and the fact that it is in nowise an improvement on the intrapharyngeal method of administration.

CLINIC OF THE SAN FRANCISCO HOSPITAL RADIATION THERAPY COMMITTEE[1]

REPORTED BY DRS. ALSON R. KILGORE, INSTRUCTOR IN SURGERY, UNIVERSITY OF CALIFORNIA, AND W. EDWARD CHAMBERLAIN, ASSOCIATE PROFESSOR OF MEDICINE (RADIOLOGY), STANFORD UNIVERSITY

I. FIBROSARCOMA OF SOFT PARTS CAUSING PATHOLOGIC FRACTURE OF THE FEMUR AND GIVING *x*-RAY APPEARANCE OF PERIOSTEAL SARCOMA

W. M., a man of twenty-seven, in December, 1921, kicked a crate of fruit with his left foot, felt an immediate sharp pain on the inner side of his left thigh, and the following day noticed a small *movable* lump at the point where the pain had occurred. He watched it grow for eighteen months, by which time it had reached a diameter of 8 inches, occupied most of the anterior and inner aspect of the thigh, and had become fixed.

He was seen at this time by one of us (A. R. K.) and the *x*-ray shown in Fig. 187 obtained. A Roentgen diagnosis of periosteal sarcoma had been made, but on account of the history of origin as a movable lump, the *x*-ray appearance of regularly margined bone erosion and the lack of demonstrable vertical striations in the soft tissue shadow, as well as the absence of *x*-ray evidence of lung metastasis, it was felt that a less malignant tumor might be present and exploration was urged.

The patient refused operation, however, and was not seen again until a year later, when he was admitted to the San Francisco Hospital with a pathologic fracture. *x*-Rays shown in

[1] The Radiation Therapy Committee of the San Francisco Hospital consists of the radiologist on duty, the radium consultant, and a surgeon-pathologist from the service of each university. This committee reviews each week the cases of malignancy in the hospital and such other cases as may be suitable for radiation therapy.

Fig. 187.—Bone destruction of femur from pressure of soft parts—fibrosarcoma. Eighteen months after first observation of tumor.

Fig. 188.—Case I. Femur two and a half years after first observation of tumor. *A*, Pathologic fracture. *B*, Vertical markings in tumor shadow. (In the original *x*-ray film these markings are more numerous and much more obvious than can be shown in reproduction.)

Fig. 188 were then obtained, showing less clearly defined margins of bone erosion and well-marked coarse striations vertical to the axis of the femur. A Roentgen diagnosis of periosteal sarcoma was again made.

On account of the pathologic fracture through the nearly completely destroyed femur shaft, hip-joint disarticulation was performed.

The oval, encapsulated tumor, measuring 15 x 27 cm. in diameter, is shown in cross-section in Fig. 189. The cut surface

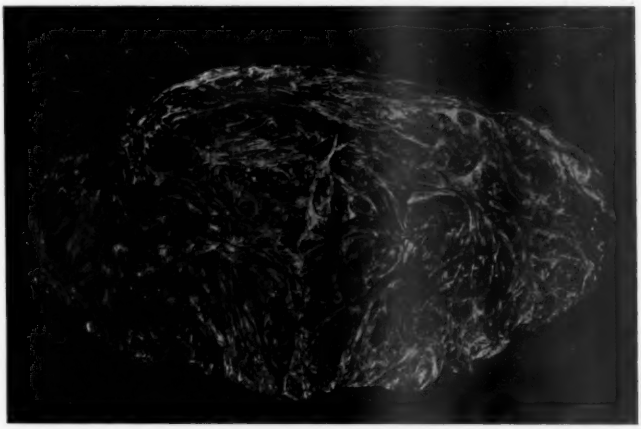

Fig. 189.—Case I. Photograph of slice of tumor. The fibrous striations lie in irregular whorls throughout most of the tumor, while at the lower margin (next the bone shaft) they have a definite vertical arrangement.

presented a densely fibrous surface with long sweeping whorls of dense white tissue interspersed with more translucent, grayish areas—the typical gross appearance of fibrosarcoma. Microscopic sections confirmed this diagnosis, presenting typical sweeping whorls of long, thin spindle cells embedded in a large amount of eosin-staining intercellular substance.

As shown in Fig. 189, the dense white fibrous strands in that part of the tumor nearest the bone lie definitely at right angles to the axis of the shaft. No bone spicules or calcification could be found in the tumor, and we concluded that the *x*-ray appear-

ance of vertical striations must have been produced by these fibrous strands. An *x*-ray of a slice of the tumor after removal demonstrated the shadows cast by these strands of dense tumor tissue.

The patient enjoyed an uneventful convalescence and is now well a year and a half after operation (four years after he first observed the tumor).

There seems no reason to doubt the patient's history of observation of a small, movable (soft part) tumor at onset. With growth of the mass to enormous size the femur atrophied from pressure until pathologic fracture occurred; and the case is presented, therefore, as one of a comparatively benign soft-part sarcoma causing pathologic fracture of the femur and also giving, on account of dense fibrous striations, the appearance in *x*-ray of vertical markings, usually considered pathognomonic of periosteal sarcoma.

II. TRAUMATIC GIANT-CELL TUMOR OF CLAVICLE

H. A. T., twenty-five, received a blow on the point of the right shoulder while playing football seven months before his

Fig. 190.—Case II. Drawing of gross specimen. The outer half of the clavicle has been resected and split through the shaft and overlying mass. *A*, Giant-cell tumor tissue. *B*, Dense fibrous tissue containing cartilage cells.

examination by the Committee. Five months after injury, no great inconvenience having been suffered in the meantime, he first noticed a lump at the outer end of the right clavicle, which

has gradually increased in size, and has occasioned definite but not severe pain.

Clinical examination disclosed a hard, somewhat irregular swelling attached to and on the upper surface of the right clavicle at its outer end. The skin and subcutaneous tissues overlying were freely movable and showed no circulatory changes.

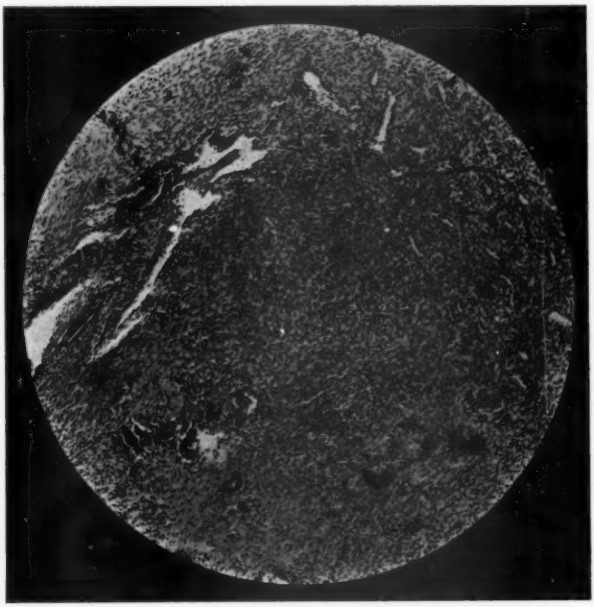

Fig. 191.—Case II. Low-power photomicrograph of tissue shown in gross specimen at *A* in Fig. 190.

x-Ray showed "an area of periosteal proliferation, with irregular but sharply defined border, apparently part of the bone, without bone destruction and without surrounding soft tissue tumor shadow or vertical markings."

A piece of tissue was excised for diagnosis and was called in one laboratory "chondrosarcoma," in another "organizing hematoma."

The patient was seen in consultation by the Radiation Therapy Committee and more sections made from the tissue which had been removed for diagnosis. In our laboratory these sections showed only dense chronic fibrous tissue. Excision of the mass, including the outer half of the clavicle, without preliminary radiation therapy was advised. This was done and the specimen shown in Fig. 190 obtained.

The illustration shows one-half of the split clavicle and attached mass. The cortex and medullary cavity of the clavicle presented no abnormality except the proliferation of dense bone underlying the mass. The mass is composed of dense white, almost cartilaginous fibrous tissue, with a small area in the center consisting of soft, spongy, reddish tissue without fluid exudate.

Microscopic sections of the dense white tissue show both cartilage and dense connective tissue. Sections from the small central area show, as in Fig. 191, cellular tissue with many small, endothelial-lined blood-vessel spaces and frequent giant-cells of the "epulis" type. The cells of the stroma are small spindle-cells, with well-stained oval nuclei, typical of the cells of a fibrohemangioma or related tumor. The picture presented is apparently that of a very small, early giant-cell tumor. The presence of cartilage in the surrounding tissue is probably to be explained on the basis of proliferation following injury at the epiphyseal line.

The case is presented as of interest on account of its bearing on the question of the origin of giant-cell tumors in abnormal repair processes or as true neoplasms.

III. CARCINOMA OF MAXILLARY ANTRUM OF TWENTY YEARS' DURATION

MRS. E. J., SIXTY, presents the following history: In 1904 a tumor was removed from the region of the left maxilla and maxillary antrum. After this operation the patient remained clinically well for six years.

In 1910 the growth recurred. It was again removed, and again the patient remained clinically well for six years. In 1916 and 1918 and in January, 1919 recurrences were surgically removed. At the time of the 1918 operation the patient was markedly cachectic, having lost 65 pounds in a few months. The growth was at that time very large and hung out of the mouth.

In December, 1919 radium treatments were begun, the growth being deemed inoperable. *x*-Ray studies at that time showed involvement of sphenoid, entire left orbit and maxilla, and a part of the mandible. The left eyeball protruded and was sightless.

The radium treatments were of rather moderate intensity, in the form of spaced and lead filtered packs over various parts of the face. Several treatments, at monthly intervals, produced a marked benefit, lasting for some months after the treatments were discontinued.

In the latter part of 1922 signs of intracranial pressure began to develop.

In January, 1923 full erythema doses of copper filtered, 200 K. V, *x*-ray were given to both sides of the head. This was repeated in March, 1923. These treatments were followed by a period of great improvement, but reappearance of signs of intracranial involvement made radiation therapy necessary in December, 1923, and again in February, 1924.

Patient entered the San Francisco Hospital in May, 1924 on account of severe hemorrhages from the tumor. Seen by the

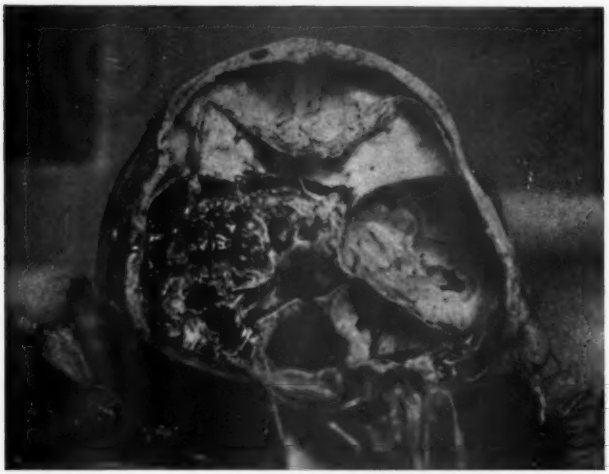

Fig. 192.—Case III. Destruction of base of skull by large tumor projecting into cranial cavity.

Fig. 193.—Case III. Photomicrograph of tissue removed at operation in 1918. Sections of tumor at autopsy showed the same histologic picture.

Radiation Therapy Committee, high voltage *x*-ray was advised, but before this could be carried out another hemorrhage occurred. Ligation of the left external carotid was done, in the course of which the patient died.

At autopsy a striking feature was the complete absence of any evidence of cachexia, and the remarkably normal appearance of all of the organs. There were no metastases.

The very large tumor in the left side of the face extended up into the cranium through a large defect in the roof of the left orbit (Fig. 192).

Previous pathologic reports, based upon tissues removed at operations, had variously diagnosed sarcoma, angiosarcoma, and hemangiosarcoma. Dr. Ophuls reviewed the whole case and interpreted the microscopic appearance as that of carcinoma of mucous gland origin (Fig. 193).

CLINIC OF DRS. EDMUND BUTLER
AND EVERETT CARLSON

SAN FRANCISCO HOSPITAL

TRAUMATIC RUPTURE OF THE SPLEEN. REVIEW OF NINE CASES

TRAUMATIC rupture of the spleen is not uncommon. Superficial tears, giving mild symptoms and signs of peritoneal irritation, not often diagnosed as splenic injury, recover rapidly with rest. If the laceration extends deep into the parenchyma, hemorrhage may be arrested by clotting as the blood-pressure drops, only to recur again as the patient's condition improves. These are the patients who often go for hours improperly diagnosed, and only after the third or fourth recurrent hemorrhage is intervention considered. If the spleen is comminuted or torn completely from the pedicle, immediate intervention is imperative, any delay is usually fatal; death from exsanguination has taken place in such patients in less than one hour.

In our series of 9 cases, 5 were uncomplicated ruptures of the spleen. Three were accompanied by extensive thoracic injuries, lacerated liver, and contusions of kidneys. One was complicated by a rupture of the duodenum.

The splenic ruptures uncomplicated by other injuries were all operated upon; one patient did not recover. This death was due to late intervention, sixty hours elapsing between the time of injury and the time of operation.

Two patients were struck by automobiles; 1 was crushed between a street car and a concrete pillar; 1 was pinned under an overturned automobile; 1 fell from a bicycle, striking flat upon the abdomen; 1, carrying a school book under arm, street car struck elbow; 1 fell 11 feet; in 2 automobile wheels passed over bodies.

Pain and the evidence of shock are the always present clinical manifestations that should lead us to suspect rupture of abdominal viscera. In all patients in which there is a history of traumata to the abdomen, the flanks, the lower chest, even if there is no visible injury or local evidence of injury, we must always be alert and not overlook the slowly developing shock, the slight distention, and the abdominal pain, not too severe, that are the early signs of rupture of the spleen.

Pain continues as long as bleeding is active, not severe pain such as is present in rupture of the stomach or intestine, but a continuous pain similar to that present in the lower abdomen following a rupture of an ectopic pregnancy. Later, as the blood spreads, the pain becomes more generalized. Two patients complained of pain in the left shoulder. Almost all complained of dizziness at some time or another. Nausea and vomiting were noted in all. Two complained of rectal tenesmus.

All were tender to palpation, most marked early in the uncomplicated cases in the left upper quadrant. Rigidity was always present, but in some patients very slight. Slight distention was always present; dulness in the left flank was noted in 2 patients.

The pain subsides when the bleeding stops, only to recur if the clots are dislodged.

The leukocytosis was above 16,000 in all but one patient. Erythrocytes numbered around 4,000,000 and the hemoglobin was near 70 per cent. The blood changes are not as marked as one unfamiliar with such cases would expect (Fig. 194). The leukocytosis remained high in those patients who recovered through the stay in the hospital.

The treatment of a ruptured spleen is splenectomy. It is folly to operate upon a patient in profound shock; transfusion, morphin sulphate, external heat, and warm salt solution by rectum will often bring about a rise in blood-pressure and subsequently operation may be more safely performed.

A long right rectus incision, an oblique incision along the ribs, or a transverse incision all give good exposure. The fluid blood, if uncontaminated, may be citrated and run into the vein

of the arm during the operation. This autotransfusion was performed in two of our series.

If hemorrhage has stopped, as is manifested by the subsidence of pain and shock, conservative treatment—rest, heat, proctoclysis, subcutaneous salt solution—is rational. Upon any evidence of recurring hemorrhage immediate operation must be considered.

The lacerations of the spleen usually run transversely or obliquely to the long axis. If the bleeding has been great and

Number	Age	Injury	Time of Accident	Time Entered Hospital	Time of Operation	Pre-Operative Diagnosis	Leucocytes	Erythrocytes	Hem.	Recovery	Autopsy
E.B.	15	Fell from auto	12/ 5/25 ?	12/ 6/25 1:45 A.M.	12/ 6/25 5:30 A.M	Ruptured spleen	39,000 75%	4,400,000	75%	+	
O.L.	8	Fell 11 ft.	5 /22/25 9:30 A.M	5/22/25 10:25A.M	5/23/25 6:30 P.M	Ruptured spleen	37,000 82%	4,000,000	62%	+	
W.J.F.	15	Fell from bicycle	2/ 1/25 8 A.M. ?	2/ 1/25 11:50 P.M	2/ 2/25 7 A.M.	Internal injuries	10,800 70%	4,150,000	78%	+	
F.B.	16	Arm struck by car	4/ 4/21 8:40 A.M	4/ 4/21 10:40 A.M	4/ 4/21 1:40 P.M	Ruptured viscera	32,000 94%	-	72%	+	
F.S.	9	Struck by auto	12/30/22 5:50 P.M	12/30/22 6:10 P.M	1/ 2/23 1:15 P.M	Mesenteric thrombosis	24,000 88%	-	-		+
J.K.	27	Crushed car and pillar	11/ 4/22 2:30 P.M	11/ 4/22 3 P.M.	11/ 4/22 4 P.M.	Ruptured liver	31,000 82%	3,900,000	70%		+
W.W.	19	Fell under auto	4/ 6/25 9:30 P.M	4/ 6/25 10 P.M.	4/ 7/25 1:15 A.M	Internal hemorrhage	25,000 80%	-	80%		
L.J.B.	61	Struck by auto	0/ 1/24 10:10A.M	0/ 1/24 10:30A.M	None	Internal thoracic & abd. injuries	16,000 82%	-	-		+
A.N.	65	Auto accident	5/30/24 5 P.M.	5/30/24 5:30 P.M	None	Thoracic and abd. injuries	-	-	-		+

Fig. 194.

shock during operation is excessive, the pedicle may be clamped and the abdomen closed around the clamp. In forty-eight hours the clamp may be loosened, but is not to be removed for at least twenty-four hours more.

If the kidney is also damaged, and it is necessary, we are very reluctant to transfuse, except with the patient's blood, uremia having developed in 2 patients who were transfused following nephrectomy for injury, and uremia did not develop in 3 similar cases that were not transfused.

CLINIC OF DR. HENRY H. SEARLS

UNIVERSITY OF CALIFORNIA HOSPITAL

TRAUMATIC PNEUMOTHORAX

BECAUSE of their increasing number the treatment of injuries received in automobile accidents is assuming every year a greater importance.

Many of these are of a minor character—lacerations from flying glass, contusions, and the like—but the terrific force involved often causes severe internal injuries. Rupture, or "fracture," of abdominal viscera—spleen, kidney, or liver—is not uncommon. Quite frequently thoracic injuries are seen, particularly where the car has overturned or its wheel passed over a pedestrian. The crushing force of such an accident is spent on the relatively rigid thorax rather than on the less prominent and more pliant abdomen.

With definite evidence of injury to the thoracic wall, even though apparently slight, the attending physician should consider the possibility of grave injury to the underlying viscera, particularly rupture or puncture of one or both lungs with progressive pneumothorax.

A thorough knowledge of the physiology of respiration is essential for the diagnosis and rational treatment of this type of injury. Graham has emphasized the flexibility of the mediastinal septum which permits intrapleural pressure to remain equal on the two sides, even when varying degrees of pneumothorax are obtained in one pleural cavity. Thus, a one-sided injury of this type embarrasses both lungs to a nearly equal degree. This is particularly true in younger people, while in the adult the mediastinum is more rigid, especially where there has been serious pulmonary disease. Graham further noted in his experimental

work that in the more extreme degrees of pneumothorax the animal, in attempting to combat cyanosis, increased the depth of respiration, often even to the extent that the rate was actually decreased—a logical effort on nature's part to lower the intrapleural pressure sufficiently (in spite of the pneumothorax) to cause some expansion of the lungs.

Injury to the parenchyma of the lung may result in the development of "valve pneumothorax." Here, with inspiration, air passes through the punctured lung, into the pleural cavity. With expiration the edges of the wound act as a valve and prevent the return flow of the air. An extreme pneumothorax results rapidly and pressure, even greater than atmospheric, may develop within the pleural cavity, forcing the mediastinal septum far over, dislocating the heart and collapsing both the lungs to a marked degree (Fig. 196). In such cases the tidal air approaches the vital capacity and the hazard becomes extreme. The condition may be further complicated by infection from the bronchial mucous membrane and development of empyema.

Physical examination should lead to the major diagnosis. *x*-Ray is not usually required but is of extreme value in determining skeletal injuries as well as the degree of pneumothroax. On inspection one notes cyanosis, deep respirations, and an extreme degree of diaphragmatic excursion. Palpation may reveal the crepitations of subcutaneous emphysema. Percussion elicits hyperresonance over the pneumothorax. An associated bleeding into the pleural cavity may result in dulness posteriorly. The heart and mediastinum shift away from the injured side. The so-called "coin test" may be positive. Breath sounds may be amphoric, but are more commonly absent on the injured side.

Such injuries require emergency treatment. The first and by far the most important step is the removal of air from the pleural cavities by simple aspiration. This was first emphasized by Munro and Hewson in 1767. Generally an associated hemothorax is encountered and considerable blood is removed with the air. Following aspiration, relief is immediate and striking. The color improves at once, the pulse becomes slower, the rate of respirations increase, and they become more shallow.

Measures to combat shock are next in order—morphin, transfusion, forced fluids. Oxygen should be administered constantly at first and later whenever cyanosis is noted.

In the past two years 2 cases of traumatic pneumothorax have come under my care at the University of California Hospital. The important points in their case records follow:

Case I.—E. R., eight years old, entered the University of California Hospital on November 14, 1923, with complaint of

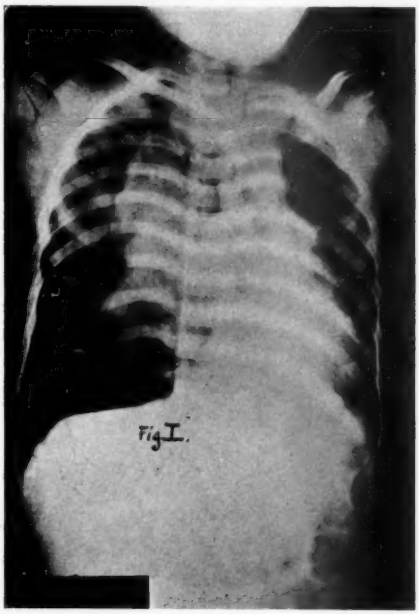

Fig. 195.

dyspnea and fever following injury received two days previously, when struck by an automobile. The left clavicle was fractured. The left arm was held tightly against the body by a modified Velpeau bandage. Cyanosis and difficult, deep respiration were evident. The patient begged constantly that the bandages be

removed. This was done with marked subjective relief. Chest examination revealed hyperresonance and amphoric breathing on the right. *x*-Ray (Fig. 195) revealed right pneumothorax without evidence of fracture of the ribs. Temperature, pulse, and respirations were increased. The diaphragmatic excursion was marked. The right ear drum was discharging. (The subsequent course of the ear condition and appearance of the

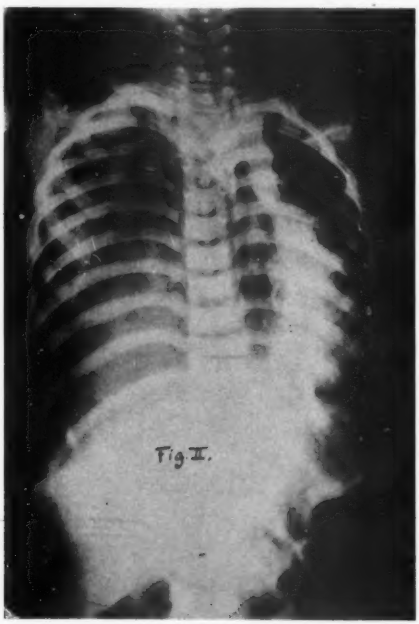

Fig. 196.

drum led to a diagnosis of probable traumatic rupture of the ear drum.)

Supportive treatment, including oxygen inhalations, but without thoracentesis, was followed for the first week. *x*-Ray findings (Fig. 196) indicated that the pneumothorax was becoming progressively worse, and one week from entry a needle attached to a manometer was inserted into the right pleural cavity.

There was sufficient positive pressure present to blow the fluid, (alcohol) out of the manometer. It was estimated that about 400 c.c. of air were removed at this time. Withdrawal was stopped because the patient began to cough up bloody sputum. On the following day thoracentesis was repeated and 160 c.c. of air, together with 340 c.c. of sanguinopurulent fluid, were removed. Culture of the fluid showed a hemolytic streptococcus. Treatment from that date was aimed chiefly at the complication of a streptococcic empyema, *i. e.*, multiple aspirations followed by drainage (closed method) with Dakin irrigations.

The patient was discharged January 24th, after ten weeks hospitalization, subjectively well. There remained a markedly thickened right pleura still containing a small amount of air. The empyema was cured.

Especial points of interest in this case follow:

1. It is believed that the injury to the lung was due to a marked increase in pressure of its contained air at the instant of application of sudden violent external force, causing an actual bursting or rupture of the parenchyma. The presence of a traumatic rupture of the eardrum and the absence of subcutaneous emphysema support this view.

2. This patient illustrates the progressive type of pneumothorax due to the valve-like action of the wound in the lung—the so-called "valve pneumothorax"—which may proceed to a positive pressure within the pleural cavity, causing an extreme dislocation of the mediastinal septum and compression of both lungs, leading to asphyxia unless relieved by thoracentesis.

Case II.—I. B., six years old, was seen in consultation at the Emergency Hospital on July 25, 1925. Two hours previously the front wheel of a large sedan had passed over her chest from the right shoulder diagonally downward to the left costal margin at the midaxillary line.

At the emergency hospital she was given an oxygen-carbon-dioxid mixture to combat cyanosis and the chest was strapped with adhesive to prevent pain from fractured ribs. She had lost consciousness.

Although the patient's pulse was rapid (150–170), and there was marked cyanosis, yet it was noted that respirations were relatively slow and very deep, with marked diaphragmatic excursion. Having witnessed and repeated Graham's demonstration of slowed, deepened respiration in experimental pneumothorax in the dog, and taking into account the nature of the accident, we were led at once to consider lung injury with pneumothorax. Subcutaneous emphysema on both sides and marked hyperresonance over the entire chest confirmed the diagnosis. Without delay both pleural cavities were aspirated, large quantities of air in the form of bloody bubbles being removed. The patient's color improved immediately, she regained consciousness, sat up, and asked for water.

After transfer to the University Hospital her condition became worse and bilateral aspiration again caused improvement. Considerable blood was withdrawn at this time along with about 250 c.c. of air.

To aid in hemostasis as well as to overcome the advanced degree of shock, the patient was given a transfusion of whole blood with considerable improvement. This was supplemented with repeated hypodermoclyses. Small doses of morphin with atropin gave considerable relief during the first twenty-four hours.

A third and final thoracentesis was done on the day after entry, 200 c.c. of air and 30 c.c. of blood being withdrawn on the right and 30 c.c. of air and 30 c.c. of blood on the left.

The course from then on was uneventful (Fig. 197), the patient being discharged on August 31, 1925, without disability.

Further points of interest in the case are:

1. The *x*-ray diagnosis of a probable associated pneumopericardium (Fig. 198), indicating a wound in the pericardial sac permitting entry of air from the pleural cavity. No other evidence could be found of this condition.

2. The remarkable recovery from the skeletal injuries. These consisted of (1) fracture of the coracoid process and body of the right scapula; (2) fracture of the right clavicle; (3) fracture of the fourth, fifth, sixth and seventh right, and fourth, fifth and sixth left, ribs.

It is believed that the initial thoracentesis was definitely life saving, as improvement was immediate and remarkable.

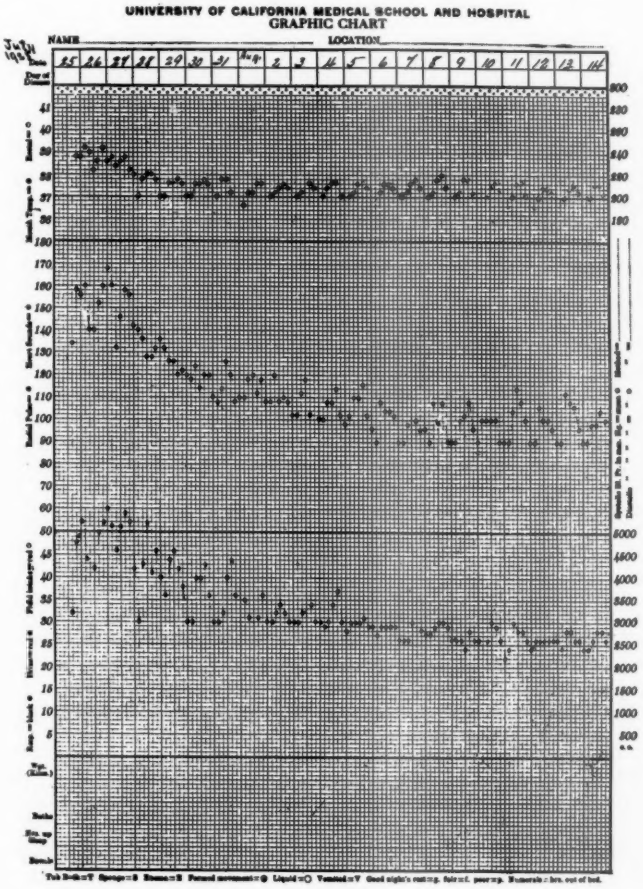

Fig. 197.

Summary.—1. Lung injuries with associated acute pneumothorax are not uncommon, particularly in patients hurt in automobile accidents.

2. Diagnosis is suggested by cyanosis and exaggerated depth

of respiration, subcutaneous emphysema, hyperresonance, amphoric or absent breath sounds on the injured side, and dislocation of the heart and mediastinal septum.

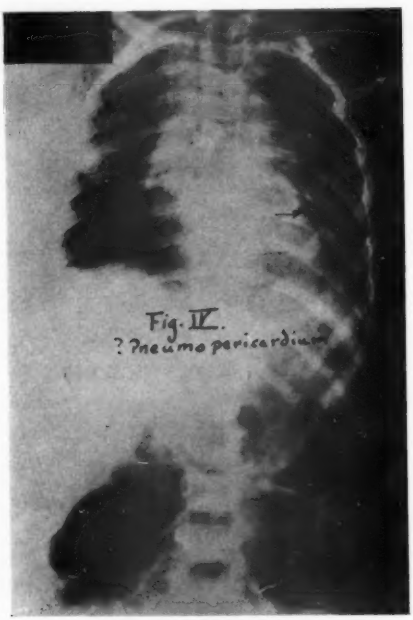

Fig. 198.

3. Emergency treatment should primarily be aspiration of air from the pleural cavities, repeated as often as a recurrence of the condition demands.

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DIFFERENTIAL POINTS BETWEEN THE TWO COMMON TYPES OF TOXIC GOITER

As the treatment of goiter has progressed, the clear differentiation between the two common types of toxic goiter, exophthalmic and adenoma with toxicity, has assumed an increasingly important position.

Before these two conditions were recognized as clear cut clinical entities, their management remained in confusion; since that recognition it has been placed on a logical basis.

The following classification of thyroid disease is quite generally accepted today.

I. Simple Hypertrophy (adolescent goiter).
II. Colloid goiter.
III. Adenoma: (*a*) Non-toxic; (*b*) toxic.
IV. Hyperplasia (exophthalmic).
V. Malignancies: (*a*) Carcinoma; (*b*) sarcoma.
VI. Thyroiditis.

From a clinical standpoint toxic adenoma and hyperplasia are the two most important types. On casual examination they resemble each other quite closely. In both types the patient may complain of goiter, nervousness, palpitation, tremor, loss of weight and strength, sweating, and increased irritability. These points enable us to make the diagnosis of toxic goiter, but this is not sufficient. A carefully developed case history will practically always give enough additional information to further qualify the case, either as one of hyperplasia or toxic d enoma.

Inasmuch as the treatment and prognosis in the two types differ radically, the importance of accurate differentiation is evident. Although surgery for both types is winning more and more recognition, yet their proper management requires entirely different lines of treatment—preoperatively, at the table, and during convalescence. For example, while the proper administration of iodin, pre- and postoperatively, has a markedly favor-

able influence on hyperplasia, it is positively contraindicated for adenoma, causing a rapid aggravation of toxicity.

The patient with toxic adenoma of the thyroid is, except in the very neglected case, an excellent surgical risk. Little or no preoperative care is required. Convalescence is rapid and complete. The patient with exophthalmic goiter requires careful preoperative therapy—Lugol's solution and rest in bed for a week or ten days, high caloric diet, etc. Operation is more difficult. There is generally a fairly severe immediate postoperative reaction (controllable for the most part by administration of Lugol's). Convalescence is prolonged and may fail occasionally to progress to a complete cure. The disease involves several of the endocrine glands, the thymus, adrenals, and ovaries being commonly affected. Following operation there is a readjustment within the endocrine system which may or may not bring the patient completely back to normal.

DIFFERENTIAL POINTS

Hyperplasia:	*Adenoma:*
1. Exophthalmos (about 70 per cent.).	1. No exophthalmos.
2. Thrill and bruit over thyroid.	2. No thrill or bruit.
3. Symmetric goiter of uniform consistency.	3. Asymmetric nodular goiter.
4. Parallel development of goiter and toxicity.	4. Goiter of years' duration before toxicity develops.
5. Rapid development of toxicity to advanced degree with periods of remission.	5. Slow progressive development to a moderate degree without remissions.
6. Etiology—(?) psychic trauma. (?) oral infection.	6. Etiology—endemic.
7. Typical blood-pressure 140/60.	7. Typical blood-pressure 160/100.
8. B. M. R. ranges from 40 to 70 per cent. +.	8. B. M. R. from 25 to 50 per cent. +.
9. High percentage of lymphocytes.[1]	9. Normal blood-picture.
10. Rarely substernal or intrathoracic.	10. Most substernal and intrathoracic goiters are adenomatous.
11. Rarely any pressure signs or symptoms.	11. Commonly pressure a main complaint.

[1] The differential white blood-count in 100 cases of hyperplasia showed an average of 41 per cent. of lymphocytes, in 250 cases of toxic adenoma, an average of 33.5 per cent.

Having demonstrated the need for recognition of these two clinical entities, the differential points as shown on page 530 are offered as aids in differentiation.

Rarely will any one case show a complete differential picture, but in a very high percentage a sufficient number of points may be found to determine the diagnosis.

CLINIC OF DR. HOWARD H. MARKEL

FROM THE ORTHOPEDIC SERVICE OF THE MEDICAL DEPARTMENT OF THE UNIVERSITY OF CALIFORNIA

A CASE OF BILATERAL CONGENITAL DISLOCATION OF THE HIP

I PRESENT for your consideration this child, a boy, Japanese, twenty-two months old. The family history is of no importance. His parents realized that he walked late—that is, instead of walking at a year or thereabouts, he did not walk alone until he was eighteen months old. Also, when he did walk it was with a peculiar waddling, duck-like gait, which is typical of this condition. He was a perfectly healthy baby boy and suffered no pain at any time. One thing of note about him is that he is a boy, for congenital dislocations occur much more frequently in girl babies—7 or 8 to 1. This one happens to be one of the exceptions to the usual rule.

Upon examination we find abnormal mobility of the hip-joints—flexion, abduction, and rotation all beyond normal upon palpation—and in the groin we find the pulsation of the femoral artery. Normally the artery crosses the femoral head, which can be felt as a fulness beneath it and can be felt to move under the finger as the leg is rotated. Here, however, there is a deep softness beneath the femoral artery and the head can be palpated behind the ileum. The same condition is present on both sides.

Radiographs taken stereoscopically show the heads of the femora lying outside of the acetabuli, cephalad and dorsad to the acetabuli. The condition of the acetabuli attracts our attention, first because they are rather flattened—that is, the roof over them is poor and the rims seem poorly developed. The femoral heads also present variations from the normal.

Because the epiphyses of the heads have not borne weight against the acetabuli, the centers of ossification are much smaller than normal. This is easily seen in unilateral cases, where a marked difference in development is seen. This boy is a good age for treatment, as the centers have ossified sufficiently to show their position in the *x*-ray, even though in a plaster cast.

One other condition attracts our attention—that is, the angle of the neck with the shaft. In the normal case there is about

Fig. 199.—Before manipulation.

15 degrees of anteversion of the neck, causing the head to look forward slightly when the feet and the patellæ are held straight anteriorly, as the radiologist is instructed to do when taking these films. But often there is as much as 90 degrees anteversion, particularly in an older case. In this case there is about 45 degrees.

These two variations, the lack of a proper superior lip on the acetabuli, and the anteversion of the necks and heads are two of the causes of the very frequent relapses in these cases. Quite naturally, if the head is pointing far forward and the rim of the acetabulum is very shallow, it is quite easy for dislocation to recur when weight bearing without restraint is allowed. The third cause lies in the stretching of the capsule of the joint, causing it to become long and narrow as a stocking does, hence it becomes constricted between the head and the acetabulum, making it extremely difficult, if not impossible, to thread the head

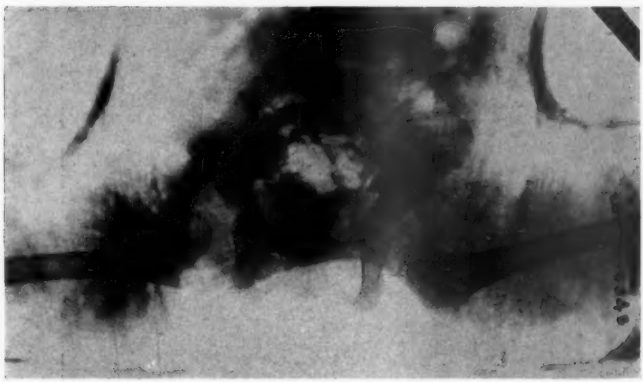


Fig. 200.—After reduction, taken through plaster-of-Paris cast.

through this constricted opening into the acetabulum. Instead, in many cases, the capsule is merely pushed ahead of the head into the socket. In these cases relapse easily occurs if weight bearing is allowed without proper support before sufficient time for atrophy of the capsule has occurred.

Methods of treatment are various. I will not go into the history of this operation, except to say that for centuries nothing was done for these cases, and, while as children they got about quite well, when they got older they were quite incapacitated, tired easily, and had to sit a great deal. As a consequence, as they were not sick, but had good appetites, they quickly took on weight, which still further interfered with their activities.

About thirty years ago the Italian surgeons first successfully reduced these hips. Lorens, of Vienna, learned it there, and has done thousands since. Various methods of reduction have been devised, both closed and open. In this clinic we always try the conservative method first, then if that fails we do open work. In this case, under full ether anesthesia, we first stretch the contracted adductors. This we do after the method of Denuce, who firmly abducts the leg, and deep pressure and hard rubbing

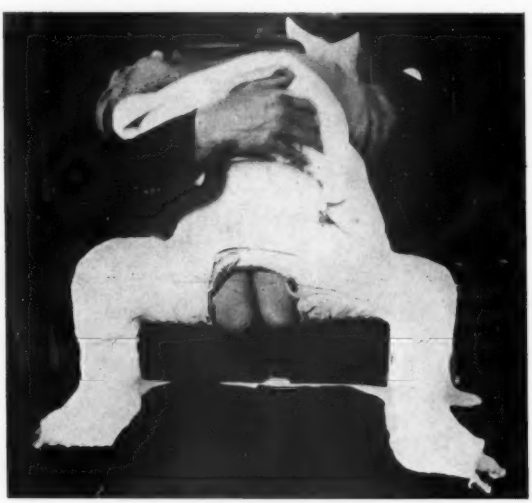


Fig. 201.—Patient in frog position in double plaster-of-Paris spica after reduction.

loosens them, using talcum powder on the skin to prevent irritation. After these are well stretched, taking twenty or twenty-five minutes for it, the capsule is stretched by fully flexing the hip and knee and then pressing upon the flexed knee. Now, using one hand as a fulcrum beneath the trochanter, the head is levered into the acetabulum. The stretching is done on the two sides simultaneously, but the hips are manipulated separately.

Now the resident surgeon says that his hip is in, and to prove it we have him dislocate it, when it slips out with a snap, and again he reduces it. Then the other side is reduced, and the hollow beneath the femoral artery is gone, but in its place is a hard fulness, which is the head in its acetabulum, distending the capsule. But it is soon found out that they will not stay firmly in with the hip internally rotated as we prefer, but they must be put up externally rotated into the so-called frog position. With the patient's sacrum supported on a spica saddle and his shoulder on the padded top, a double plaster-of-Paris spica is applied from midchest to the toes, lined with sheet wadding and padded with felt over the bony parts. The thighs are well abducted as this position firmly presses the heads into the acetabuli, and we expect it to be deepened by pressure atrophy. After the cast is hardened the anesthetic is stopped and the patient is returned to bed. When the cast is dry, which will take a day or two, an *x*-ray will be taken to check up the condition. If it is satisfactory, the patient will be asked to return in about six weeks and a new cast fitted, bringing the legs down slightly. This is repeated every six or eight weeks until the legs are down in a walking position. Soon after this the cast is left off and an elastic rubber spica made to hold the trochanters in. This is kept on for some months as the child walks. He should be kept under observation for several years to see that no dislocation recurs. If it does, an open operation should be done, the acetabulum exposed, and the upper lip of the acetabulum lengthened by making a curved cut into the ileum about 1 cm. from the edge of the acetabulum and prying this downward. Behind this ridge should be put a bone block, secured from the wing of the ileum above. This usually prevents dislocation due to the poor socket. But an osteotomy of the femur below the trochanter may be necessary if repeated dislocation occurs in cases where there is from 45 to 90 degrees of anteversion of the neck. In this case I believe the conservative treatment will do the work.

Stereoscopic *x*-ray plates taken the following day through the cast showed the femoral heads properly in the acetabuli.

CLINIC OF DR. EDGAR LORRINGTON GILCREEST

UNIVERSITY OF CALIFORNIA HOSPITAL

SPINDLE-CELL SARCOMA OF THE SOFT TISSUES OF ANKLE

MALIGNANT tumors more than any other surgical entity have yielded less to the progress of surgery. Chief among these malignant tumors in their deadly toll are sarcomata.

Based on the morphology of the tumor cells and on their histogenesis a sarcoma may be defined as a malignant tumor composed of cells of the connective-tissue type.

As pointed out by Boyd, malignancy is evidenced in two ways, by invasion and metastasis. The infiltrating powers of sarcoma are notorious. Metastases are early and wide-spread.

The spindle-cell sarcoma represents the purest form of fibroblastic neoplasms and constitutes the majority of sarcomata met with in practice.

Character of Growth.—The growth of sarcoma is usually rapid. Their abundant blood supply favors very active cell growth. Degeneration often takes place because the great rapidity of the growth outstrips the supply of nourishment. Their size is often further increased by hemorrhage and mucoid degeneration. The hemorrhage, due to the thin-walled character of the vessels, is followed by liquefaction of the tissue. Metastasis takes place early, usually through the blood-stream rather than through the lymphatic channels.

The case which I wish to present was a man aged forty, who worked at a large packing house, and who came to my office on July 21, 1924, complaining of excruciating pain of the outer side of his left ankle, which he stated he had struck four days before against a hard object. Although the impact was very painful he was able in a few moments to continue with his work for the

rest of the week. On this day, however, on attempting to work his ankle became so painful that he could not continue.

Examination.—There is a large indurated swelling greater in size than a lemon in the region of the left external malleolus. In one area slight fluctuation can be palpated.

Preliminary Treatment.—As he was moaning so audibly and apparently in such agony aspiration was done at once under local anesthesia, and 10 or 15 c.c. of sanguinous fluid were withdrawn which gave him immediate, complete, and lasting relief from all pain in the ankle.

Roentgen-ray examination revealed no bony pathology, but only a soft tissue swelling in the region of the external malleolus.

Progress.—He was sent immediately to the hospital for further observation. With rest in bed, elevation of the foot, and application of hot compresses the swelling in the region of his ankle somewhat subsided, but at the end of the week some induration could still be felt. When questioned repeatedly as to ever having had a former injury to his ankle he consistently said no. He was taken to surgery and under local anesthesia an incision was made 2 inches long over the tumor and some blood clots evacuated and then some soft degenerated tissue was found, which had the appearance of tumor cells, and which was removed for a pathologic diagnosis.

Pathologic Report (Dr. Rusk).—There are small spindle-cells compactly and diffusely growing; the nuclei are relatively large, the cytoplasm scanty; numerous cells in mitotic division are observed. Diagnosis: Spindle-cell sarcoma.

Clinical Course.—A few days following the operation this man who had no intention to deceive suddenly remembered that he had been struck on this same ankle three months before. He thought little of it, except a small lump the size of an acorn persisted on the outer side of his ankle. He was advised of the diagnosis of sarcoma. Amputation was suggested, but not urged. It was declined. Skiagraphs of his lungs at this time, August 5th, showed no evidence of metastasis. He went to another hospital where sections were taken again from his ankle and from a gland of the groin, which were diagnosed as non-

malignant. This encouraging report gave him renewed hope, but it lasted but a short time as he soon began to expectorate some blood and a skiagraph of his lungs taken October 1st revealed metastases. He continued to grow weaker and died on October 9th.

Autopsy Report (Dr. Rusk).—Sarcoma arising in the tissues about the left ankle. Metastases to left groin and to the middle lobe of right lung. Pneumonic consolidation with small abscess in middle lobe of right lung. Fibrinopurulent pleurisy (500 c.c.) about right lung. Hypostatic congestion of lungs. Cloudy swelling of viscera.

Discussion.—I am glad to be able to cite this case if only to emphasize one point and that is any neglected tumor in any portion of the body is dangerous and that only by giving attention to its removal can an occasional life be saved. We should never miss an opportunity to try to educate the public on this matter. This case also shows how sarcoma occasionally metastasizes through the lymphatic stream as well as the blood-stream.

MELANOMA

A MELANOMA or melanotic sarcoma is a malignant pigmented tumor arising from a specific mesoblastic cell, the chromatophore, and possibly from epithelial cells which have been modified by pigment production. It originates in the great majority of cases from a pre-existing pigmented mole or nevus, but may arise in the choroid coat of the eye. The pigmented mole or nevus occurs chiefly on the face, neck, and back. Besides these seats of origin it may arise from the brain, meninges, adrenals and ovaries.

When it begins to grow the skin becomes thin over it and it bleeds easily, after which the growth is for awhile very rapid.

As pointed out by Boyd, the metastases are the most important feature of a melanoma. The primary growth seldom attains great size, nor does it occasion any serious clinical disturbance. It is the wide-spread metastases which constitute the lethal factor. The spread is by blood and lymph.

As to the nature and origin of this tumor pigment, while many questions are still left to conjecture, chemical investigations have thrown much light on the subject. In varying proportion carbon, hydrogen, and nitrogen are found.

The case which I wish to bring to your attention is a woman aged forty-four, the wife of a Lieutenant-Commander of the Navy, who presented herself one morning complaining of severe pain in the region of a pigmented mole just under her left ear. She stated that she had had this mole all of her life, but three weeks ago while at Lake Tahoe she had noticed that the collar of her coat seemed to rub it and make it tender. On returning to San Francisco the mole formed a little blood blister. Sterilizing a needle she attempted to open it, but nothing came out. For the past two days she has had such severe pains in her neck that she had been unable to sleep.

The past history is essentially negative with the exception that five years ago in New York she became poisoned with acetylene gas in an apartment house and developed afterward an acute nephritis and ever since has been on a salt-free diet.

Special Examination.—There is a pigmented mole on her neck just below the left ear. There is a hemorrhagic area on the surface. On palpation it is slightly indurated, but seems freely movable and some very small glands are palpable beneath the skin.

Diagnosis.—Old pigmented mole evidently showing signs of melanosarcoma.

Operation.—An incision was made well around the tumor and carried down through the subcutaneous tissue where a lymph-gland was found to have already undergone metastasis as evidenced by the disposition of pigment within it. In removing this there was a rather stringy substance like a blood-clot which seemed to follow down the lymphatics, and which on removing seemed not to be blood, but the soft pigment of the melanoma. It did not seem justifiable under the conditions to do any mutilating operation, as I have been unable to find an authenticated case of ultimate recovery in a melanoma after metastasis had occurred.

Pathologic Report (Dr. Rusk).—Microscopic examination shows a new growth lying immediately beneath a more or less flattened epithelium of the skin, consisting of relatively large cells growing massively and containing in places abundant pigment. In other areas the cells contain relatively little pigment, but the connective tissues in these regions are excessively pigmented. The growth infiltrates into the subjacent fibrous tissue and a lymph-node lying a few millimeters beneath the superficial mass shows about three-quarters of its surface occupied by a similarly pigmented growth. In other regions a small transplant is seen in the subcutaneous connective tissue.

The cells are uniform in character, large, with relatively large nuclei, the amount of protoplasm varying and those cells which are heavily pigmented in general appear somewhat larger. Cells in mitotic division, while not especially numerous, occur. Diagnosis: Melanosarcoma.

Although this woman has been almost completely free of pain in her neck since the tumor was removed one month ago, I feel that she already has minute and wide-spread metastases, although they have not yet manifested themselves. She is receiving a few *x*-ray treatments on her neck for the sole reason of retarding, if possible, any further metastasis. Melanuria is still absent.

This case emphasizes the importance of advising all patients who consult us of the advisability of removal of all moles, as it is so well known that they not infrequently are the starting points for these very malignant tumors. This woman, who had traveled extensively over the world, had been examined many times by physicians and, unfortunately, had never been advised to have this mole, which was very visible on her neck, removed.

TWO CASES OF SUBCUTANEOUS RUPTURE OF THE LONG HEAD OF THE BICEPS FLEXOR CUBITI

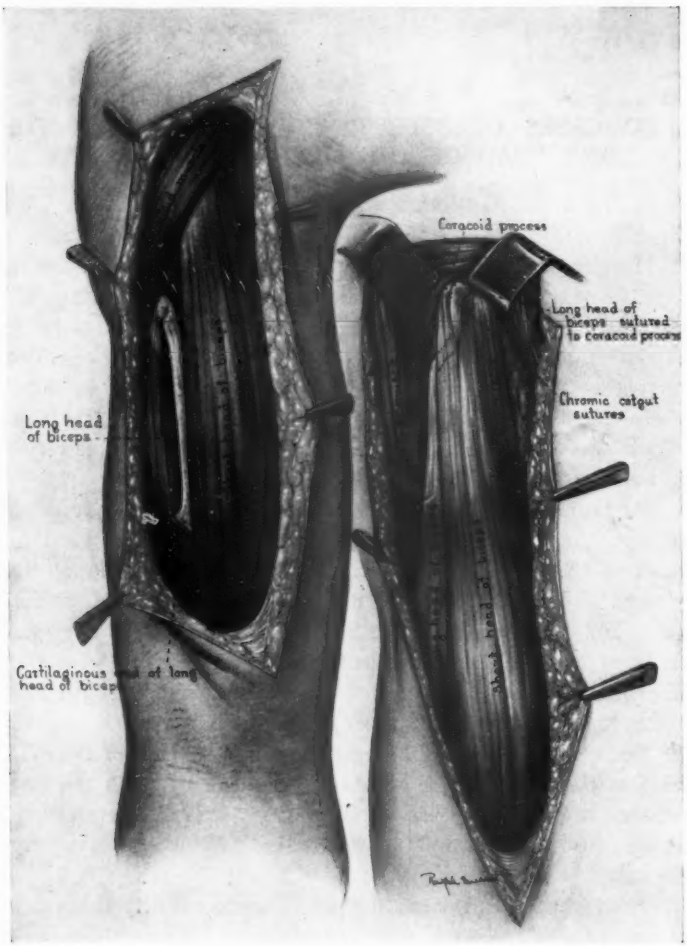
BEFORE the Western Surgical Association in French Lick Springs in December, 1924, I discussed the subject of Rupture of Muscles and Tendons and referred particularly to subcutaneous rupture of the biceps flexor cubiti.[1] I stated that unfortunately this subject had received only the most meager mention in American or English text-books on Surgery and I further added that these ruptures, complete or incomplete, occurred much more frequently than is generally supposed and that the condition was usually undiagnosed for months or years, resulting in valuable loss of time before operation.

At that time I presented a fresh case seen a few hours after injury. At operation was found a complete rupture of the long head of the biceps torn off from the cartilaginous lip of the glenoid and turned over on itself in a jack-knife-like fashion (Fig. 202, *a*). Repair is shown in Fig. 202, *b*. I am glad to be able to say after the expiration of exactly one year this man has complete restoration of movement and strength and states that his arm and shoulder feel perfectly normal.

Today I have another interesting case of rupture of the long head of the biceps which substantiates what I said in the first paragraph relative to delay in diagnosis. It is also interesting, as the cause was one of direct and not indirect force, as is usually the case.

The history is briefly as follows: The man is fifty-two years of age. He is a giant in stature and among his co-workers was known far and wide as "Steam Beer Brown." He was famous for two things, to wit, for the large schooners of beer he was able to drink before our country reached its present desiccated state, and for his great feats of physical strength. His favorite stunt out on the job was to get some co-worker to lift all he could

[1] This paper was published in the Jour. Amer. Med. Assoc., June 13, 1925.


Coracoid process
Long head of biceps sutured to coracoid process
Chromic catgut sutures
Long head of biceps
Cartilaginous lip of long head of biceps

a *b*

Fig. 202.—*a*, Condition found in operation which shows the long head of the biceps torn off from the cartilaginous lip of the glenoid completely turned over in a jack-knife fashion; *b*, long head of biceps sutured to coracoid process and fortified to upper fibers of the short head.

and then for him to put this man on the load he had lifted and lift him with it. But the days of our modern Samson were limited, and he states that on April 18, 1924, just eighteen months ago, he was taking off brackets and staging when a box upon which he stepped gave way, throwing him against a 2 x 12 plank, the impact of his body being received by the anterior portion of his right shoulder. The pain in his shoulder was severe and any movement of his right arm increased it. Since this injury he states his shoulder has always been lame, getting better when he rested it and getting sore and tired when he attempted to do heavy work. On the top of the shoulder, when turning his arm, he has often felt a crepitation which he refers to as "his coffee grinder." As he was unable to pursue his former work his case had been referred to the California Industrial Accident Commission for rating, the diagnosis being "old chronic arthritis of the shoulder."

Present History.—On September 5, 1925, while leaning over and lifting a plank 2 x 12 and 16 ft. long, which he had raised about 3 feet from the ground, he felt a sharp pain in the top of his right shoulder extending down into his biceps; at the same time he heard a snapping sound over the biceps muscle. The pain made him feel "sick at his stomach." Since that time the soreness has continued in his arm and shoulder and he has been unable to work.

Special Examination (September 14, 1925).—Right shoulder and arm.

1. Some slight atrophy of right shoulder and upper arm is visible.

2. An ecchymosis along belly of long head of biceps and a distinct tumor mass in lower and outer third of arm are seen. A hiatus can be felt above this.

3. On palpation of shoulder-joint a very definite crepitation is felt.

4. On having patient flex arm the tendon of the long head of the biceps does not tighten corresponding to long head in the other arm.

5. He complains of pain in top of shoulder over insertion of long head of biceps and along belly of muscle.

6. There is a voluntary abduction to about 45 degrees.

7. Extension of forearm causes pain in upper arm and shoulder.

Diagnosis.—Rupture of the long head of biceps flexor cubiti (right).

Operation (September 24, 1925).—Under general anesthesia a lineal incision was made over the belly of the right biceps muscle and extended up the arm. When the muscle sheath was opened some serum exuded from the region of the tendon of the long head of the biceps. On further dissection an almost complete rupture of the tendon of the biceps muscle was found which had, so to speak, jack-knifed on itself and had firmly grown together. There was a small remnant of the tendon, about the diameter of a match, still remaining. By sharp dissection the tendon, which had ruptured and had grown together, was liberated and then turned up and sutured to the periosteum of the coracoid process. This fixation was further fortified by sutures through the fibers of the short head of the biceps (Fig. 203, *a* and *b*). The soft tissues were approximated by interrupted catgut sutures. The skin was closed in the ordinary way. The arm was flexed on the chest and immobilized under a Velpeau bandage.

Postoperative Note (Six Weeks).—Since the operation this man states that he has been free of nearly all pain. He mentions particularly the freedom of pain on top of the shoulder and the absence of the crepitation giving him the sensation of a coffee grinder. This can be accounted for, as the strand of tendon which was left traversing the cavity of the shoulder-joint and emerging from the capsule into the bicipital groove no longer has any strain on it as this stress has been taken by the main portion of the tendon which was sutured to the coracoid process. The swelling in the lower third of the arm is absent and his biceps has now a normal contour. I feel that it is unnecessary after such an operation to put the arm in a cast or an abduction splint. A Velpeau bandage serves as well and is much more

comfortable. Physiotherapy, consisting of heat and massage, is begun the end of the second week and to this is soon added

Fig. 203.—*a*, Condition found in operation which shows an old rupture of the upper end of the long head of the biceps which has jack-knifed and grown together. A small remnant of the tendon is seen coming down from the shoulder-joint. *b*, Suture of long head to coracoid process and to upper fibers of short head.

passive and active exercise. Today this man has active abduction to 115 degrees, and overhead extension almost to normal.

For a discussion of the etiology, mechanism, site of ruptures, and diagnosis of ruptures of the biceps see my article referred to above.[1]

Fig. 204.—Six weeks after repair of rupture of biceps.

Fig. 205.—Four and a half months after operation.

A review of the literature for the past 200 years reveals the first reported case by Pettit. Since that time there have

[1] Jour. Amer. Med. Assoc., June 13, 1925, vol. 84, p. 1819.

been 79 more, and these 2 cases make a total of 82. Of this number, only 16, including these 2 cases, have been reported in the literature as coming to operation.

Since taking up the study of rupture of muscles and tendons a year ago I have had a number of letters from physicians in the United States and Canada, each telling me of an interesting case of rupture that he had seen. Perhaps the most interesting one I have to relate comes from Dr. C. B. Horton, of Toronto, Canada. He tells of "an aged imbecile at the Ontario Hospital for Insane, who had been completely helpless for years and had to be fed and cared for. One morning on going the rounds the attendant reported that this man had a large swelling with an ecchymotic appearance in the region of the left pectoralis major muscle." He adds, "I was not aware of the cause until a day or two afterward when I explored the hematoma with the intention of evacuating the clot and of hastening recovery. I found a complete rupture of the pectoralis major with the upper portion drawn into a tense mass at the anterior border of the axilla and the lower portion forming a raised edge along the costal origin of the muscle. It is my present recollection that the clavicular portion of the muscle was unaffected. There was no history of injury, and the rupture evidently occurred while the patient was in bed."

PLASTIC OPERATION FOR REPAIR OF TRAUMATIC AMPUTATION OF END OF FINGER

A BOIL is of no concern to anyone except to the one who has it. The loss of the end of a finger may seem at first of slight significance, except to the one who has sustained such an injury. Paderewski and Heifetz insure the tip of a finger at the rate of about $10,000. The case which I wish to present is a young lady who cut off the end of her right middle-finger in a paper-cutter. The sharp knife made a clean amputation through the end of the finger at the level of the proximal and middle third of the finger-nail. Since I had this case I have asked many surgeons in various parts of the United States the procedure they would follow, and invariably they all have said that they would reamputate, removing the remnant of nail in order to secure a good flap. This was exactly the procedure which first occurred to me. Then I decided to try this simple method. With rongeur forceps I bit off the bone until a flap of tissue on the palmar surface could be brought up, covering the bone. With a small, curved cutting needle threaded with fine silkworm-gut sutures, this flap of skin was brought up over the bone and the needle was passed through the remnant of the nail. Five sutures made a satisfactory approximation. I had never sewed a flap of skin to nail before and did not know that it would adhere below. I was delighted, therefore, at the end of a week, to see that this flap of skin had grown beneath the nail and after removal of the sutures there was no separation. I have not been able to find any case in the literature where soft tissues had been sewed to the base of the nail. Six weeks after the operation she was able to play a piano, using the stump of the amputated finger just as well as the other fingers. The end of the finger, which at first had a blunt fan-shaped appearance, rounded off like a normal finger. The length was exactly the same as her

ring finger. The nail, of course, while only half-length, made an

A B

Fig. 206.—Plastic operation for repair of traumatic amputation of end of finger. Taken three months after operation. A, Middle finger, right. B, Middle finger, left.

inconspicuous deformity. The accompanying photograph (Fig. 206) was taken six months after the accident.

CLINIC OF DR. JOHN HOMER WOOLSEY

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WOUND INFECTIONS

ACUTE infections are, as a rule, treated according to rote and without pertinent thought to the object desired. They are also treated in a lackadaisical or sloppy manner. Incision, drainage, moist dressings, and an antiseptic, chosen because of its popularity in our medical journals or in the verbose literature that constitutes the bulk of our daily mail, is the usual treatment.

When one person obtains such excellent results with a chlorine antiseptic and another in a similar instance obtains equally as good results with a hypertonic salt solution, or when wound infections are successfully cleared in several instances by an equal number of different antiseptics there must be some other great underlying factor or factors. Principles of physiology are the underlying factors, and the treatment must be along these lines to obtain the quickest and surest response.

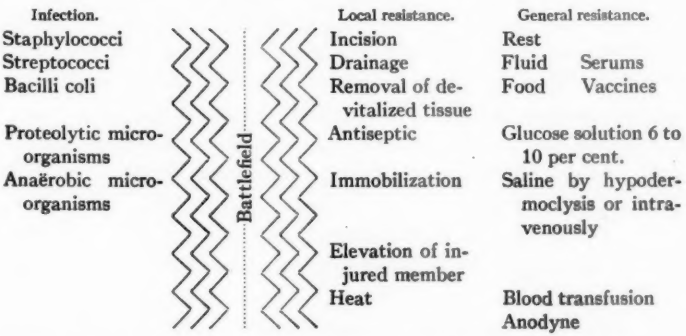

Fig. 1.—Graphic chart of battle between infection and body defense.

The conflict that occurs between the body and an infection is like unto the battle between two enemies. On the offense we have the infection, and on the defense there is the local tissue resistance mobilized to its greatest extent, aided and supported by the general resistance powers of the body.

Diagnosis.—The history of onset, the clinical course, the amount of local involvement, the type of tissues involved, the degree and type of lymphatic response, the general bodily symptoms, the graphic chart, the blood-picture, and the urine examination tell us the comparative severity of the infection, the power of resistance of the patient, and thus the type of treatment best to employ.

To handle the enemy intelligently one must know the type of fighting forces and then the treatment can be directed to the critical point. For example, be it staphylococcic, the treatment is to a large extent local, but if it be diphtheric the treatment is chiefly general. Therefore the bacteriologic identification of the type of infecting micro-organism is equally important.

Treatment.—The treatment in all infections has certain definite lines along which to work:

(1) Elimination of the infective micro-organism and its products; (2) deflection of the serum and lymph flow to the surface; (3) removal or destruction of the micro-organisms' food supply; (4) improvement of the local resistance; (5) improvement of the general resistance, and (6) employment of vaccines and serums.

Elimination of the Infective Micro-organisms.—Infections that are to the main extent active locally and causing slight general reaction should first have incision and drainage to remove the micro-organism and its products. The incision should be proportionate to the size of the wound; should be so constructed as to be along cosmetic lines and to give easy drainage. The incision should be at the most superficial point and, if possible, at the most dependent portion. Facial planes need a portion excised or a small cross-incision, since otherwise a valve action is likely to result.

Drains are, as a rule, necessary and should be of material that will hold the wound open and yet not act as a cork. Gauze

in any form soon has its mesh filled with coagulated lymph and does not drain. Rubber is the most ideal substance we have at present, and at times should be employed in rubber-tube or rubber-band form so as to keep the wound edges apart. As a rule, rubber-dam is the most useful type. Drains function so as to divert the flow of lymph and serum, for, as Horsley says, the body apparently looks upon a drain as a foreign body which it should expel.

Moist dressings to prevent the superficial coagulation of lymph and serum and thereby the formation of a crust are most essential. The solution used in which the dressings are soaked must be hypertonic so as to cause a flow of serum to the surface. Such dressings have their value enhanced by being applied in as sufficient heat as the patient can tolerate with comfort. Compresses of $\frac{1}{4}$ per cent. lysol, magnesium sulphate, hypertonic sodium chlorid, sodium hypochlorite (Dakin's solution), or glycerin and alcohol, equal parts, have proved the best. The last is an excellent solution to employ in the home, for its consistency is known and antiseptic qualities are definite. These dressings should be applied every three or four hours, covered with some material impermeable to fluids, to prevent evaporation or loss of content, and aided in heat by hot-water bottles.

Removal or Destruction of the Micro-organisms' Food Supply.—Micro-organisms do not live upon viable tissue, but upon tissue the blood-supply of which is injured. The late war forcefully brought to our attention the rôle of devitalized tissue. The excision of all traumatized tissue whose blood-supply was destroyed and the removal of foreign débris proved eventually to be the most important part of the war wound treatment. This procedure was known as a débridement. Débridement is now being applied by many to burns, furuncles, carbuncles, with a resultant more rapid recovery. In burns of all degrees the excision of the dead tissue prevents the absorption of the broken-down protein material and assists in giving an earlier clean base for healing or for skin-grafting. In infected wounds the removal of the pabulum upon which the micro-organism lives is a measure of prime importance. Infected wounds should be examined

carefully with each dressing for necrotic tissue, and this excised. A nitrous oxid anesthesia for a few minutes with a proper débridement will mean a saving of days in convalescence and prevent further extension of the infection. In the infection of the hand or foot, all raised dead skin edges, underneath which the micro-organisms can live at a point somewhat inaccessible for the antiseptic, should daily be excised back to viable tissue. An antiseptic should be chosen that has properties for digestion of the devitalized tissue. Authorities vary as to this point, but the author's experience is definitely in favor of the sodium hypochlorite solution as described and applied by Carrel, or by the equivalent of this, which can be easily made from the tablets or solution obtainable from reliable pharmaceutical houses. The sodium hypochlorite solution has a definite action upon the necrotic tissue, but must be employed properly, that is, as an instillation, not an irrigation, and must be conducted to the area of the wound where it is needed. The so-called "Carrel tubes" will at times need to be perforated for varying distances and, again, should be open at the end. The antiseptic must be administered so as to keep the infected area bathed sufficiently frequently to inhibit the growth of the micro-organisms and to carry on the digestion of the devitalized tissue. This may be every hour, two hours, or four hours. Thus by destroying the micro-organisms' food supply, either chemically or by physical removal, the micro-organisms can eventually be eradicated.

Improvement of Local Resistance.—The tissues locally involved in an infection can be materially helped if a good blood-supply is maintained. This means not only bringing oxygen and nourishment to the body cell but also the removal of products of catabolism. Rest or immobilization should be one of the greatest features of treatment of all traumatic or infective injuries. It is too seldom employed and frequently means the difference between failure and success. Elevation combined with rest will aid in securing the maximum blood-supply. In a streptococcic lymphangitis or cellulitis this is the most important feature of treatment. A burn will become comfortable with rest, while before with movement even narcotics have been felt to be

necessary. Heat in the form of moist compresses or with interval soaks tends to dilate the local blood-vessels and aid in the cell metabolism. The compresses must be large, should cover the area of infection by at least a 25-cm. (10 inches) margin; should be so applied as to retain the heat, and should be renewed with such frequency as to prevent a chilling of the local tissue. Soaks give the best results with interval employment rather than continuous, for the latter tends to a marked puckering and wrinkling of the skin, in which infection may gain a new hold. Rest, elevation, and heat then should be some of the first measures of our treatment armamentarium in infected wounds or localized infections.

Improvement of the General Resistance.—The strength of an athletic team is often described "as strong as the reserve." Likewise the reserve or general resistance of the patient may decide whether the battle will be successful or not. Attention to the general condition is essential when we consider operative treatment or the amount of exercise to be allowed the patient. A first measure of importance is a need of complete rest to conserve all the physical energy to combat the infection. Such rest means bed, good nursing, happy surroundings, and freedom from irritation or excitement by visits of relatives and friends. Fluids, such as water, alkaline water, milk, and orange juice, should be given by mouth up to 3000 mils. (3 quarts) daily for the ordinary adult. Hypodermoclysis of Ringer's solution or N sodium chlorid or intravenous administration of N saline solution or glucose solution in 6 to 10 per cent. may often be advisable. This fluid is necessary for the nourishment of the body cell and to aid in the elimination by kidneys, skin, lungs, and wound discharge of the toxins of the infective micro-organisms and the catabolic products of the body. Blood transfusion in instances of anemia should be employed, and early rather than late in the infection, as so usually is done. The blood should be given by the sodium citrate or simple whole blood methods so as not to disturb the patient too greatly, for the nervous excitement attending this procedure is very exhausting in many instances. Food easily digested that can be taken by the patient, and prepared

and served in a delectable manner, is a third measure. Soporifics and narcotics to provide necessary rest and freedom from pain respectively should be administered as judgment directs.

Employment of Serums and Vaccines.—There are certain infections, such as diphtheria, anthrax, tetanus, and Bacillus welchii, whose course is most favorably influenced by the use of the antitoxins, which in every instance should be used in relatively large amounts to be of value. The use of serums in streptococcic infections is disputed; is apparently dependent upon the type, but they are of no value and should not be employed during active infection. Vaccines have no place in acute wound infections, as their action depends upon the stimulation of the body to form new antibodies against the infection when already the body is being sufficiently stimulated. In repeated isolated infections of a staphylococcic nature the autogenous vaccines are worth while and produce an immunity for a varying period of time. The heterogeneous use of serums and vaccines is greatly to be condemned. In the former instance sensitization to horse-serum is often developed that later may interfere with a necessary life-saving treatment. In the latter a definite scientific reason should be present or harm will be done to the patient in lowering an already fair body resistance.

Conclusion.—1. Wound infections should be treated actively and scientifically with all the known measures along lines of physiology.

2. Determination of the type of infective micro-organism whose mode of action must first be known.

3. The valuable measures of treatment are:

(*a*) Local rest or immobilization.
(*b*) Development and stimulation of local resistance by position and heat.
(*c*) Incision and drainage.
(*d*) Excision of devitalized tissue.
(*e*) Choice of antiseptic.
(*f*) Conduction of antiseptic to the area of infection.
(*g*) Support, development, and stimulation of general resistance.

RIGHT SUBDIAPHRAGMATIC ABSCESS

Abscess in the right subdiaphragmatic region while somewhat difficult to diagnose is more difficult to locate. The treatment has been greatly advanced by the operative approach through a more anatomic route. An exploration by the same route can be also made and without shock to the patient.

Anatomy.—The location of subdiaphragmatic abscess has been well outlined by Barnard and later by Lockwood. Briefly, on the right side, it may be located in the right anterior intraperitoneal space, right posterior intraperitoneal space, or the right extraperitoneal space.

The right anterior intraperitoneal space is located between the anterior portion of the right lobe below and the diaphragm above, the falciform ligament to its mesial side, and the coronary and right lateral ligaments behind. The right posterior intraperitoneal space is the so-called Morison's pouch, or subhepatic area, located below the right lobe of the liver and bounded by the liver and gall-bladder in front and above; the upper pole of the right kidney and posterior margin of diaphragm behind; the abdominal wall laterally and mesially by the tissues of the common duct, hepatic vessels, and their mesentery.

The right extraperitoneal space is located between the two portions of the coronary ligament and is bounded above by the diaphragm and below by the uncovered liver area.

The two right intraperitoneal spaces may connect with one another or may lead to other areas, as through the foramen of Winslow or down along the outer side of the right colon. The right extraperitoneal space, however, remains distinctly by itself except in some instances of long duration, when it may rupture through the diaphragm and possibly empty into a bronchus.

Source.—The subdiaphragmatic abscess arises as a secondary affair subsequent to other infection. Intraperitoneal infection

due to a perforation of the gastro-intestinal tract is the most common preceding lesion, a perforated appendix or a perforated peptic ulcer being the rule. Such lesions as perinephritic abscess, empyema, thoracosis, hemorrhoids, ischiorectal abscess, and even skin infections are, at times, followed by a secondary abscess in the subphrenic area.

There is a direct drainage by gravity to the right posterior intraperitoneal space. Lymphatic drainage accounts for a large proportion. Origin from a hepatic abscess subsequent to a blood-stream infection is at times the history. Direct extension from a perinephritic abscess or an empyema thoracosis or a right colic abscess may occur.

Diagnosis is made first upon the history of a preceding infection as outlined above, then a course of chills, fever, general malaise, tenderness to pressure along the right costal margin, and a steady dull pain referred according to the area of diaphragm involved. Physical examination may show some fulness in the right upper quadrant or a bulging of the right costal margin; a lack of diaphragmatic excursion to inspection; a tenderness locally along the right costal margin and over the three lower ribs, accompanied occasionally by an edema. The liver dulness may be increased. Rigidity of the right rectus may be present. Lateral flexion of the spine will be less to the right than the left. Excursion of the diaphragm will be lessened or absent to percussion. Breath sounds will be absent or decreased in amount and length, and occasionally crepitant râles at the right base due to neighborhood congestion will be present.

Laboratory aids, as the blood-picture gives an idea of the presence of an inflammation and the degree of toxicity. The value of urine examination is revealed in a negative manner as well as positively. The *x*-ray is the greatest aid to diagnosis, as it tells us of deformity of the diaphragm and the failure of mobility, and the location of each by observing the patient at various angles under the fluoroscopic screen.

Case Report.—This young boy of thirteen years was injured one month ago by having an iron rod of an automobile driven into his epigastric region. There then resulted considerable im-

mediate shock, moderate hemorrhage, and a perforation of the stomach.

The wound was immediately closed with drainage and a transfusion of blood given. The wound reopened, and in the intervening month two more transfusions and four operations have been performed in order to close the gastric fistula, and properly drain a posterior intraperitoneal subphrenic abscess.

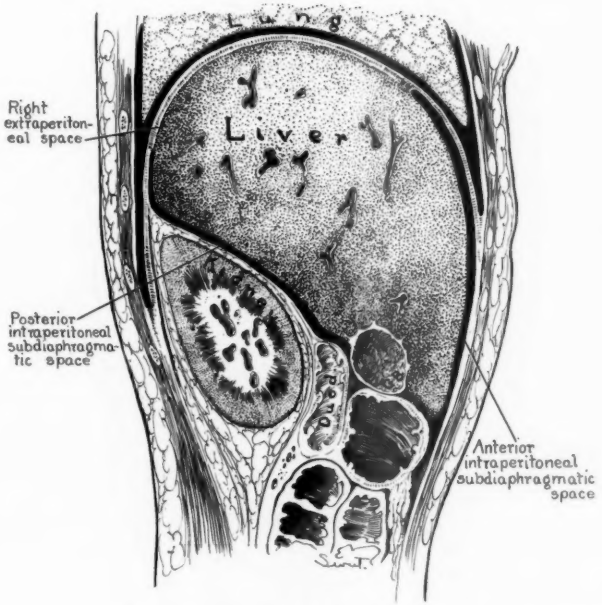

Fig. 207.—Right subdiaphragmatic spaces.

Ten days ago all drains were removed and the wound that you see in the epigastric region allowed to close. However, fever again ensued, accompanied by marked general malaise and pain and tenderness along the right costal margin.

This boy entered the hospital on a stretcher, in an emaciated and anemic condition. He was unable to lift or turn himself. His temperature, pulse, and respiration were 39.5° C., 136, and

40 respectively for the first twenty-four hours. Physical examination of the chest and abdomen showed the right costal margin to be slightly more prominent and flaring than the left, with a fulness of the intracostal margin area. There was no movement of the right base, with respiration in contrast to a slightly increased movement on the left. The liver dulness extended from the fourth interspace anteriorly and the lower angle of the

Fig. 208.—Scars of wounds of injury and drainage.

scapula posteriorly down to a point 2 cm. below the costal margin. This area did not move with respiration. The right base posteriorly is tender to deep pressure and likewise the right side of the chest and the right upper quadrant of the abdomen. There is a sensitiveness of the skin over the right lower abdomen, and to the same area a dull aching pain is localized by the patient. The breath sounds over the right base are faint, of a bronchial

type, and accompanied by occasional showers of fine râles. The laboratory aids show a blood-picture of Hb. 55 per cent. (Sahli), red blood-cells 3,744,000, white blood-cells 15,450, with 91 per cent. polys.; urine examination essentially negative and *x*-ray findings as follows: "High right diaphragm with a tendency to flatten, and, under the fluoroscope, very slight movement is observed."

A diagnosis was, therefore, made of an inflammatory condition—an abscess. Then, because of the localizing signs, a high

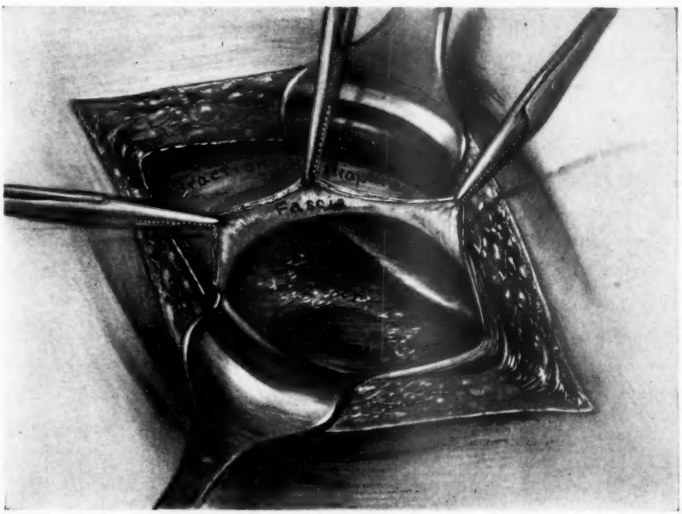

Fig. 209.—Exposure by the right lumbar incision.

posterior and lateral chest dulness continuous with the liver area, the tenderness to pressure and the radiation of pain to the right lower quadrant along the lower six intercostal nerves, that likewise supply the outer area of the diaphragm, the abscess was clinically located in the right extraperitoneal space. The *x*-ray evidence of a flattened diaphragm with greater deformity posteriorly substantiated the diagnosis of the location.

Treatment.—Some means of approach must be made to the dome of the liver in order to explore for the possible abscess and,

if found, properly to drain. In the past, exploratory puncture with an intraspinous needle through the tenth and eleventh interspaces to the subdiaphragmatic area, with thrust of the needle in various directions, and with suction on the needle, has been the usual procedure. In the majority of instances, whether

Fig. 210.—Patient six months postoperatively showing the scar of the right lumbar exploratory wound.

pus was present or not, it was not demonstrated by this method, for subphrenic or hepatic abscess pus is, as a rule, too thick to be aspirated by needle. The danger of infection of the pleural cavity is great and frequently happens. Exploration with a needle, in areas as the peritoneal cavity and subphrenic spaces, for location of pus or for diagnosis of a possible cyst, are relics of

yesterday and are dangerous. With our rapid and clean surgery and our new knowledge of prevention of shock, we have today a means of direct inspection. The next step, in the past, has been to resect a portion of the overlying rib and, if necessary, wall off, by various procedures, the sterile pleural cavity. Usually this has demanded a two-stage operation, and when the final exposure of the dome of the liver came to view, digital exploration was quite limited.

Nather and Ochsner have described an excellent method of approach as developed at the Surgical Clinic of the University of Zurich, Switzerland. In two other instances at our clinic this method has given perfect exposure and room for direct visual and digital examination.

This boy has been given 300 c.c. of citrated blood properly cross-tested, and now the exploration will be begun. The boy is put upon his left side with left leg straight and the right flexed at the hip and knee, exactly as the position used for the kidney lumbar incision. The incision of 12 cm. is made over and parallel to the twelfth right rib. This rib is now subperiosteally removed. Keeping below the twelfth rib periosteum, the incision is carried deeper to the renal fascia. Then, by blunt dissection, with the finger and the under surface of the diaphragm as a guide, the kidney and its fat are pushed down posteriorly and the liver is exposed. The duodenum, gall-bladder, and inferior intraperitoneal space lies just in front. The liver is now separated from the diaphragm by the fingers and palpation is possible over half of the liver dome.

At the anterior portion of the dome edematous tissue is palpated. The finger is gently carried forward and you suddenly see approximately 300 c.c. of thick, greenish-yellow pus drained. No other edematous tissue being found suggestive of collected pus, a dressed tube and two rubber-dam drains sufficient to hold the wound properly open are now placed. Hot moist compresses will be employed to stimulate drainage and prevent coagulation of the draining lymph and serum. The anesthesia has been nitrous oxid and oxygen only. The patient, you see, leaves the table awake and in as good shape as upon arrival.

Postoperative Course.—The temperature, pulse, and respiration gradually returned to normal by the eleventh day postoperatively. The drainage was very slight, and so the drains were gradually withdrawn, allowing the wound to heal from the bottom out. The patient's general condition improved gradually until two months after entry, when he was discharged with all wounds healed, enjoying excellent health, and registering a gain of approximately 12 pounds. The contour and mobility of the diaphragm were observed at intervals under the fluoroscope and, at discharge, reported: "Right diaphragm is rounded, moves well, and costophrenic angles are clear."

Six months after operation the patient reports a further gain of 15 pounds and excellent health. The wound has remained healed and patient has been free from any tenderness and pain.

Conclusion.—1. Right subdiaphragmatic abscess may be located in three different areas—the anterior intraperitoneal space, the posterior intraperitoneal space, and the extraperitoneal space.

2. The diagnosis is made by a preceding history of intraperitoneal infection, neighborhood infection, or more rarely skin infections, with subsequent symptoms and signs of an abscess; physical examination of an inflammation in the right upper quadrant of the abdomen, or at the right pulmonic base, and by the aid of the *x*-ray.

3. Exploration by needling through the intercostal spaces, with transit of the pleural cavity, is so dangerous and imperfect in findings that it should be forever discarded.

4. Exploration through a lumbar incision under the diaphragm is non-shocking, does not provide new avenues of infection, gives a visual and tactile means of exploration, and is an ideal position for drainage of the three right subdiaphragmatic spaces in which abscess may form.

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CLINIC OF DR. HARVARD McNAUGHT

STANFORD UNIVERSITY HOSPITAL

REGARDING ETHMOID INFECTIONS

CHRONIC infection of the ethmoid labyrinth is gradually being recognized as a source of many local and systemic disturbances. The word "gradually" is used advisedly, for pathology in this region is often not thought of by the general practitioner and almost as frequently not diagnosed by the rhinologist.

The ethmoid labyrinth consists of a series of cells which communicate with each other and drain by different routes into the nose—the anterior group drains "under" the middle turbinate, and the posterior "over" the middle turbinate. It is because of this complex structure and the position of the ostia that drainage in the ethmoids is very easily blocked, and this, as we shall see, is an important factor in the production of chronic infections. So important is drainage, that it can be said that with few exceptions some interference with it is necessary for the production of chronic, infectious changes in the ethmoids.

The condition chiefly responsible for lack of drainage in the nasal sinuses is, in the vast majority of cases, a deviation of the septum. This may cause a blocking of the ostium to occur in several ways—first, by directly passing against the middle turbinate, which as it grows, in turn, is pressed into the hiatus semilunaris, against the ostia of the anterior ethmoids, frontal and antrum; second, by disturbing the blood-supply of the mucous membrane, causing hyperplastic changes which ultimately block the ostia.

Chronic ethmoiditis may be divided into two groups: (1) Chronic suppurative inflammation; (2) chronic catarrhal inflam-

mation (or hyperplastic ethmoiditis). Inasmuch as the chronic purulent conditions of the ethmoid are comparatively uncommon and present no great difficulty in diagnosis, we will not now consider them, but proceed to a brief review of the second classification.

Here we have distinct changes taking place in the ethmoid labyrinth, chiefly as a result of imperfect drainage. These changes, while distinctly infectious in character, do not result in chronic pus formation, though at times pus is seen in an acute exacerbation.

There are often few or no macroscopic changes in the nose. When these occur they may be so slight as only to be noticed by comparing the two sides. We may enumerate them as follows: (1) Gradual broadening of the base of the nose; (2) enlargement of the bulla ethmoidalis; (3) slight polypoid degeneration of the turbinal tissue. This occurs chiefly on the outer side of the turbinate (and may be only seen on evulsing the turbinate toward the septum) and on the posterior end, where it may be seen by postrhinoscopy or the nasopharyngoscope.

How then in the absence of pus, or demonstrable changes in the nose, are we to diagnose an affection of the ethmoids?

The first way is by means of the clinical history. The patient presents a history of oft-repeated rhinitis with a characteristic nasal origin. He often has an irritating thin discharge which excoriates the lip, or may not, or drips down the throat. If the latter, and it is from a unilateral infection, we may and usually do have a distinct enlargement of the lateral pharyngeal glands behind the posterior pillar on the same side. This alone often leads us to think of a chronic sinusitis. He may or may not have pain and, if present, this may vary in character from neuralgia to steady ache, or a constant dull pressure between the eyes.

Often the local or systemic disturbances lead us to think of ethmoidal infection, and we are enabled by excluding other sources finally to indict this region. Among such local symptoms are pain, as before mentioned; also, neuralgic pains in the bulb, and ciliary neuralgia, scotoma, photophobia. Optic neuritis,

often proceeding to atrophy, in the absence of systemic conditions, leads us at once to think of the ethmoids. Many cases have been reported in which drainage of the ethmoids resulted in cure.

There may be, also, a disturbance of the olfactory sense.

This may be anosmia, or inability to smell anything, or may assume the form of cacosmia, which is a subjective appreciation of an offensive odor. If a frontal lobe tumor can be excluded as a cause of anosmia, we should be led to think of the ethmoids. Certain conditions in the body may be caused by focal infections and the ethmoids are very frequently overlooked as the possible source of trouble. Such conditions are neuritis, arthritis, mental hebetude and loss of memory, chronic bronchitis, chronic laryngitis, asthma, chronic nephritis, neurasthenia, and many others. Particularly should our attention be directed to the ethmoids in the chronic respiratory diseases. A constantly growing proportion of cases of asthma are found to have a chronic hyperplastic ethmoiditis as the etiologic factor. In these cases, cleaning out the ethmoids which are infected, as well as giving attention to other sources of systemic infection, should result in a cure or great relief from the symptoms.

Much has been written lately concerning allergic conditions; and hay-fever, hyperesthetic rhinitis, and asthma have been placed under this head. As we all ingest and inhale proteins the question arises as to why we do not all become allergic. In other words, there must be some underlying cause which determines that one individual shall have a reaction in the nose, which we know as hay-fever, from breathing a certain pollen, and others escape. Certain studies seem to show that some damage to the endothelial cells may allow undigested protein to be absorbed and produce allergy—and that infection may well be the source of the endothelial change. If this hypothesis is true, and clinical evidence would tend to confirm it, then the ethmoids may be a very important source of such infection.

The writer finds that ethmoidal infections of the hyperplastic type are responsible for the larger number of asthmatic conditions. Suggestive of such a relationship is the fact that a

large proportion of hay-fever subjects later become asthmatic. Can this not be explained by the gradual production of ethmoiditis by the blocking of the drainage caused by the hay fever? Clinically, it is true that many patients whose ethmoids have been properly drained have lost their allergic reactions.

The subject is too extensive to be handled in its entirety and the object of this paper will have been achieved if it calls attention to the possible systemic disturbances which may arise from hyperplastic ethmoiditis, and that such may exist even in the absence of gross pathology or of *x*-ray evidence.

It may be well to add that the after-care of these patients is very important until healing of the operated area is complete and permanent, with the reduction of granulations and polypi by various means, such as mechanical removal, silver nitrate, and the Dowling tamponade. Appropriate treatment for elimination by the skin, kidneys, and bowels is always given by the internist and is very essential in the proper conduct of the case.

The cases which are appended illustrate some of the conditions mentioned.

Case I.—Mr. G. M. J.; age fifty-two; presented himself on June 5, 1920.

Complaint.—Asthma; nasal stenosis and violent sneezing.

Past History.—About two years previously noticed what he thought was a chronic cold. There was no pus, but a continuous watery discharge. This continued about twelve months, when he began to have violent sneezing which continued about six months, when the asthmatic attacks began.

Status Præsens.—The septum was deviated to the right. On evulsing the middle turbinates a slight polypoid swelling was seen on the outer side. Both middle turbinates were in contact with the septum. No pus. The *x*-ray was negative for sinus infection. The antrum wash was negative.

Treatment.—Submucous resection of the septum was done, with complete exenteration of both ethmoid regions. The ethmoid labyrinth was found to be full of polyps and much serous exudate.

Note.—With the exception of a few very slight asthma attacks immediately following the operation, the patient has been completely free of symptoms of asthma since then up to the present time.

Case II.—Major M. L. B.; age forty-eight; was seen first in August, 1923.

Complaint.—Asthma since twenty years old, which allowed him to sleep only a few hours per night at intervals.

Past History.—No family history of asthma or allergy. He has been treated by many physicians with no marked results. He reacts to house dust, feathers and several food proteins, and was treated by Cook with a vaccine containing these proteins without results. He has noticed that when in the country for a length of time his attacks become less in number and milder. He has also noticed that he usually feels symptoms resembling a coryza, accompanied by a watery discharge, preceding the severe attacks.

Status Præsens.—The septum was deviated to the right and the spacing on both sides was poor. No pus. The outer sides of both turbinates were hypertrophied. The nasopharynx was negative. The tonsils were hypertrophied and contained pus. The *x*-ray was negative for sinus infection.

Treatment.—On the clinical history, influenced largely by the fact that his symptoms were improved by residence in the country—which would not have been the case had his condition been purely allergic—I did a preliminary tonsillectomy, followed shortly by a submucous resection and double ethmoidectomy.

Note.—Up to the present time the patient has been entirely free from his asthmatic attacks and can eat and handle substances, to which he was formerly sensitive, without producing reactions.

Case III.—Mr. J. S.; age forty-three.

Complaint.—Nasal obstruction for years, with frequent colds.

Past History.—Complete anosmia which has lasted twenty years. Rhinorrhea at all times which is irritating to the skin during acute exacerbations.

Status Præsens.—Septum deviated to the left. Both middle turbinates are of the so-called cystic type and in contact with the septum. No pus on either side. Nasopharynx and pharynx negative. The *x*-ray showed slight clouding of the left ethmoid region. From the clinical symptoms alone it was decided that the ethmoids were at fault.

Treatment.—A submucous resection of the septum was done and both ethmoid labyrinths exenterated. The cells on both sides were found to contain many polypi and much serous exudate.

Note.—He has had few colds in the six years since the operation; the anosmia and rhinorrhea have completely disappeared.

Case IV.—Mrs. A. B.; age thirty-seven.

Complaint.—For years this patient has had symptoms resembling hay-fever—not seasonal. The attacks came suddenly and at about weekly intervals. Within a few moments of the onset of the attack the nose would drip a watery secretion which, at times, irritated the lips—the nasal passages close, and violent sneezing attacks ensue. She had been tested for allergy by the various proteins, but showed no reactions. For years this patient has had anosmia.

Status Præsens.—Except for enlarged middle turbinates in contact with the septum, there are no pathologic changes in the nose and no pus, though during attacks all the nasal mucosa was pale and swollen. The nasopharynx is normal and the tonsils absent, having been removed years ago. The *x*-ray findings were negative.

Treatment.—Both ethmoid regions were exenterated and found polypoid.

Note.—From the day of the operation there has been a complete absence of all the symptoms complained of and her sense of smell is perfect.

Case V.—Miss V. J.; age fifty-four.

Complaint.—For two years has had violent attacks of sneezing, especially on rising in the morning and on exposure to dust. The nasal breathing is much impaired, and there is a

great deal of watery discharge at such times. The attacks come on at any time of year and are very frequent. She has also frequent coryza, with systemic symptoms.

Status Præsens.—The septum is deviated to the left. Space on both sides is poor, due to the swelling of the mucosa, which is of a pale color. No pus seen. Nasopharynx is normal and the tonsils have been removed. The *x*-ray findings were negative.

Treatment.—The septum was straightened and at the same time the ethmoids were exenterated and found to be of the hyperplastic type.

Note.—Since operation the attacks of sneezing have ceased and colds are infrequent. The nasal mucosa has also assumed its normal appearance.

Case VI.—Miss J. F.; age sixteen. This patient noticed diminution of the vision in the right eye. She was seen by a competent eye man who found an optic neuritis on the right side. In spite of vigorous treatment the visual field became smaller daily. She was sent to me for nasal examination and in spite of an absence of any visible abnormalities, I advised opening the ethmoids. This was done, but no apparent changes in the cells were seen. The vision, however, began to improve from that moment and an almost complete recovery of the nerve ensued. We know that in such cases, even though no pathology is visible to the eye, the microscope will show definite signs of disease in the bone.

Case VII.—Mrs. J. K.; age fifty-six.

Complaint.—Neuritis affecting the left arm and back of neck. This had been treated by various methods for some years without relief. She had been examined by a rhinologist, who failed to find any pathology in the nose. The finding of an enlarged bulla ethmoidalis on the left side, together with watery discharge, frequent colds, and the exclusion of any other focal infection that could produce a neuritis, were sufficient to indict the left ethmoids. On exenteration they were shown to be polypoid, and the neuritis disappeared.